Don't be misled by productivity figures
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EB 200's return on equity was cut in half in '91
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How Linear Technology avoids R&D overspending
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A CAHNERS PUBLICATION

Electronic Business®

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES–WORLDWIDE

AUGUST 1992

15th ANNUAL ELECTRONIC BUSINESS

Hold your breath. Profits plunged 54% PAGE 18

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Every financial you could ever want PAGE 70

Electronic Business

VOLUME 18, NUMBER 11 — FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES-WORLDWIDE — AUGUST 1992

Cover illustration by Brad Holt

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By almost any measure, 1991 was a lousy year for the U.S. electronics industry: Profits nosedived 54% against 1990 figures—the biggest one-year drop ever—return on equity dropped by a similar amount, and hefty restructuring charges threaten to become an annual event. The good news: We got better at controlling costs, and productivity rose pretty much across the board

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Business Trends

9 A new court ruling on video-game software development could put a big chill on reverse engineering; Feds threaten hefty fines in crackdown on high-tech trade with former adversaries; Only deep-pocket vendors are likely to survive now that 'PC' means "price cuts"

PAGE 9 A California court case could lead to limits or ban reverse engineering

Maybe they were favoring one of their own, but attendees of PC Expo in June picked Ross Perot hands-down. Now what?

PAGE 57 "We often targeted our own elegant implementation of technology," admits Varian CEO Tracy O'Rourke

PAGE 65 "We didn't realize MSI Data's product line was as weak as it was," says Symbol president Martino

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bucks if their products turn up where they're not supposed to be.

Last November, the DOC established new sentencing guidelines, the most significant of which dictates higher fines for exporters that do not establish programs for tracking their controlled product exports. The idea is to prevent high technology from being acquired and used by blacklisted governments and terrorist organizations that might develop weapons of mass destruction, among other things. Blacklisted countries include Libya and Iraq, as well as Pakistan and even China.

"The problem for a manufacturer is that it can be held responsible for, say, a chip it makes that winds up in a country that is on the DOC's blacklist. Companies now find themselves subject to very heavy fines for not paying attention to export tracking requirements and the responsibilities that go with them," says Bill Chastka, president of consulting firm Washington Resources International Inc.

Although U.S. companies can't guarantee their products won't end up in blacklisted countries, the DOC is holding them accountable for having export-tracking systems in place. "It's a difficult thing to do," says Compaq Computer export attorney Joe Tasker. "There's only so far you can go to make inquiries [down the export distribution channel]."

Unfortunately, the ramifications of the new sentencing guidelines are still unclear. "It's become a matter of [companies] proving they have an effective program in place that makes everyone in the chain of distribution accountable for where products end up," says Chastka.

DEC computers, for example, were recently discovered in an undisclosed blacklisted country. The DOC investigated, and under the new rules, DEC was fined $2.4 million. That was only a fraction of the fine that could have been levied had DEC not had an accountability method in place. PC clone maker Everex Corp. was similarly fined $500,000.

The process relies too much on trust, says Opus Systems Inc. CEO Jim Katzman. Companies may sign an agreement with the clause, but either through blatant disregard or (more often than not) ignorance, they end up shipping the product to forbidden destinations.

"A lot of companies are in trouble over this one," says Chastka. "They have to educate their resellers and distributors, or they are going to get burned."

—David Webb in San Jose

Perot was the choice of PC Expo goers

Perot	42%
Clinton	22
None of the above	19
Bush	17

Dorothy Ahle

Ross Perot may be out of the presidential race, but he's taking the hearts and minds of the PC industry with him. Perot ran away with the lead in a straw poll of 1,500 attendees at PC Expo in New York in June, three weeks before the Texas billionaire dropped out of the race. The poll was conducted using the trade event's ShowNet computer-based demonstration network. —R.W.

MARKETS

Who will remain now that "PC" means "price cuts"?

What will it take for vendors to survive the PC industry price war? Efficient operations, solid service and support—but perhaps most important, lots of cash.

"Those who will be hurt most are those who don't have very deep pockets," says Bruce Stephen, analyst for International Data Corp. "Many vendors will cut prices, but sooner or later, some will have to close their doors."

By abandoning its Rod Canion-era strategy of selling only top-of-the-line PCs with fat profit margins, Compaq has removed the price umbrella under which hundreds of clone makers flourished. "Our focus is now on market share and revenue growth," Compaq chairman Benjamin M. Rosen said in June while introducing Compaq's ProLinea line of low-priced clone killers.

"Compaq is trying to be the American Airlines of the PC industry," says senior analyst William Bluestein of Forrester Research Inc., referring to fare cuts that led to an airline industry price war.

An apt analogy. In the wake of the Compaq announcement, virtually every PC vendor slashed its prices, while Dell Computer Corp. and Everex Systems Inc. responded with their own low-cost PC lines.

Smart vendors aren't focusing just on price. In a survey of PC users conducted by BIS Strategic Decisions, 79% said service and support were factors in their buying decision. Some vendors are taking that advice to heart. Epson America is offering on-site service for PCs under warranty. Almost overlooked in Dell's announcement of its low-priced Dimension PC line was a plan to expand its support services.

As with the airfare war, the PC price war will have its casualties. Northgate Computer has already sold out to Everex. Analysts were predicting Zeos's first-quarter $1.9 million loss would grow in its June quarter. Packard Bell put on hold its plans to go public. IDC's Stephen expects a number of weaker players—which he declined to identify—to either go out of business, be acquired, or retreat to other lines of business.

—Rick Whiting

15th ANNUAL ELECTRONIC BUSINESS

These were the giants of 1978—our first top 100 list

1. IBM
2. Western Digital
3. ITT
4. General Electric
5. Honeywell Inc.
6. RCA Corp.
7. GTE Corporation
8. Sperry Rand Corp.
9. Xerox Corp.
10. Litton Industries Inc.
11. Hughes Aircraft
12. Rockwell International
13. Burroughs Corp.
14. Texas Instruments Inc.
15. Motorola Inc.
16. Raytheon Co.
17. NCR Corp.
18. Westinghouse Electric Corp.
19. United Technologies Corp.
20. Control Data Corp.
21. Hewlett-Packard Co.
22. North American Philips Corp.
23. Digital Equipment Corp.
24. TRW Inc.
25. Bendix Corp.
26. Zenith Radio Corp.
27. General Motors Corp.
28. Grumman Corp.
29. The Boeing Corp.
30. Avnet
31. 3M
32. Martin Marietta Corp.
33. The Singer Co.
34. McDonnell Douglas Corp.
35. Northrop Corp.
36. Harris Corp.
37. AMP
38. General Instrument Corp.
39. Tektronix
40. Teledyne Inc.
41. Fairchild Camera/Instrument
42. Ford Motor Co.
43. Lockheed Aircraft Corp.
44. National Semiconductor
45. Memorex Corp.
46. General Dynamics Corp.
47. Varian Associates
48. Corning Glass Works
49. Addressograph-Multigraph
50. Perkin-Elmer Corp.
51. P.R. Mallory & Co.
52. Ampex Corp.
53. Beckman Instruments Inc.
54. E-Systems
55. Bunker Ramo Corp.
56. Eltra Corp.
57. Lear Siegler Inc.
58. Schlumberger Ltd.
59. Data General Corp.
60. The LTV Corp.
61. Siemens Corp.
62. North Electric Co.
63. Intel Corp.
64. Emerson Electric Co.
65. Cutler-Hammer Inc.
66. Eastman Kodak Co.
67. Matsushita Electric Industrial
68. General Cable Corp.
69. AMF Inc.
70. Leeds & Northrup
71. Textron Inc.
72. E.I. DuPont De Nemours
73. The Foxboro Co.
74. Sanders Associates Inc.
75. Mohawk Data Sciences Corp.
76. Bally Manufacturing Corp.
77. Cramer Electronics Inc.
78. Reliance Electric Co.
79. Soundesign Corp.
80. CTS Corp.
81. Sybron Corp.
82. Management Assistance Inc.
83. Data 100 Corp.
84. Storage Technology Corp.
85. Tracor Inc.
86. Oak Industries Inc.
87. Gould Inc.
88. The Telex Corp.
89. California Computer
90. Fischer & Porter Co.
91. Cincinnati Milacron Inc.
92. Bulova Watch Co.
93. Itek Corp.
94. Pitney-Bowes Inc.
95. Lloyd's Electronics Inc.
96. Conrac Corp.
97. Victor Comptometer Corp.
98. Bourn Inc.
99. Datapoint Corp.
100. Dynascan Corp.

Source: ELECTRONIC BUSINESS

Fifteen unsettling years for the ELECTRONIC BUSINESS 200

It's hard to believe, but the ELECTRONIC BUSINESS 200 celebrates its 15th anniversary this year. Led by our finance editor Linda Stallmann and consultant Jerry Wasserman from Arthur D. Little, we published the first list of top 100 electronics companies in February 1978. With IBM and AT&T's Western Electric on top, all told, the 100 sold $83 billion worth of electronics in that first year.

Those *were* the days. On average, a company in 1979's top 100 raked in a 5.8% return on sales, versus only 1.9% this year. Then, we worried that Fairchild, RCA, and Texas Instruments were making unwise decisions about something called seat belt interlocks, and we worried that the industry wasn't spending enough—3% of sales—on R&D. Still, compared with the industry's dilemmas lately, no one was really worrying too much back then.

In 1980, we announced the arrival of the microprocessor. Tandy and Northern Telecom joined the list, and Fairchild became subsumed within Schlumberger. By 1982, as Apple, Commodore, and Rolm quietly boarded the list, we heralded the arrival of the $2 billion desktop computer market, speculating it would rise to $14 billion by mid-decade. It's $80 billion now.

By 1984, with $318 million Compugraphic in last position, the 100 looked a bit top heavy. So, with the aid of a PC that then-publisher Vic Drumm bought with his credit card, we expanded the list. Thus, the first 200th company—$104 million Keytronic—arrived. Now-famous Compaq and Cray Research made the expanded 200 too, as well as unknowns like Kratos, Plantronics, and Vernitron. Today's 200th company, Integrated Device Technology, is $100 million bigger than Keytronic was in the 1984 listing.

The bubble burst in 1986 and we named that year's 200 "a tale of toil and turmoil." Merger mania took over as GE acquired RCA, GM bought Hughes Aircraft, and Burroughs merged with Sperry to become Unisys. In 1987, with Lotus too big to ignore, we added software companies. That's when Sun Microsystems catapulted into the list for the first time to position #93.

By 1988, we foolishly suggested the mature electronics industry was "finally settling down." But with Chips and Technologies and Dell Computer making the list one year later and Sun still growing at a breathtaking 161% five-year compounded annual rate, it became apparent that "settling down" was not a notion one could apply to this industry.

This year, the 200 has sold $367 billion worth of electronics products and services. Who knows what the next 15 years will bring.

—E. B. Baatz

Will profits ever rebound for the ELECTRONIC BUSINESS 200?

Blame the recession, blame restructuring, but the collective profits of the 200 largest electronics companies bombed 54% last year, the biggest one-year drop ever

By Linda Stallmann and E. B. Baatz

You thought 1988, '89, and '90 were lean years for the electronics industry? The financial performance for the top 200 electronics companies in 1991 makes those years look like a picnic. Last year's 54% decline in aggregate profits was far worse than the 1985-86 recession, when wild inventory swings led to a 20%-plus drop in the top 200's total profits for two years in a row. There is a silver lining, however. Last year's pains pave the way for at least some modest gains this year.

Here are the grim facts as gleaned from ELECTRONIC BUSINESS's annual reading of the financial reports for the top 200 largest publicly owned U.S. electronics companies:

- Sales growth slowed to a trickle. Revenue from electronics-related products and services grew just 1.4% during the 12 months of 1991 to $367.5 billion, the slowest annual gain ever.
- Stockholders suffered. Return on equity averaged only 5.8% last year, a shock to an industry that had never before delivered a return to its stockholders of less than 10%.
- Cost cutting didn't help. The top 200 ditched 4% of its work force, yet productivity gains, as measured by a weighted average of revenue per employee, remained mired at only 4.7%, less than half the encouraging gain of the year before.
- Manufacturing costs were stuck. As a share of total sales, the cost of goods sold for the 200 remained stalled at 60.9%, unchanged from the year before. That means the industry's many quality programs haven't yet driven costs down.

What happened? The recession that most economists termed *mild* certainly added to the industry's woes. Worse, though, was the impact of massive corporate restructurings by the likes of IBM, Digital Equipment, Unisys, and Texas Instruments. These four alone accounted for 26% of the total electronics-related revenue generated by all 200 companies, and their restructuring charges took a big bite from the bottom line. Together, the faltering four lost a breathtaking $3.2 billion.

Unfortunately, the red ink seemed to flow nearly everywhere last year; smaller companies were just as likely as the billion-dollar giants to have suffered losses. A total of 50 companies reported a net loss in calendar 1991, up from 37 the year before and 43 in 1985. Excluding companies with big electronics divisions such as AT&T and Allied Signal, for which only total corporate net income is reported, the pure-play electronics companies lost a combined $5 billion last year, compared with losses of only $3.5 billion in 1989 and $1.9 billion in 1985.

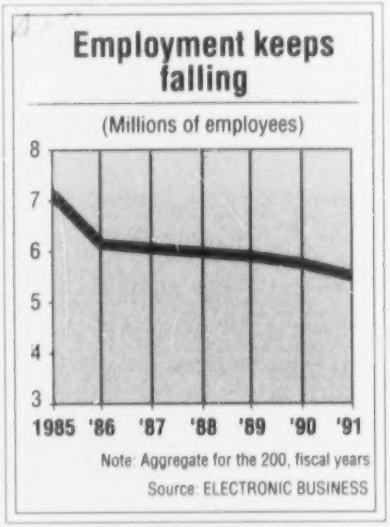
As a result, profitability slumped to a new low. Average net profits as a share of total revenue stood at a flat 2% last year. Sure, profitability had been slipping gradually from a peak of 5.9% in 1987 to 4.4% in 1990, but normally the high-flying newcomers to the 200 and the old dependables like most-profitable Microsoft and eighth-most-profitable Intel had offset the poor performers. Newcomers Syntex, Adobe Systems, and Cabletron Systems all contributed with profit-to-sales ratios of above 19%. Nonetheless, profitability for half of the top 200 wallowed below 3.3%.

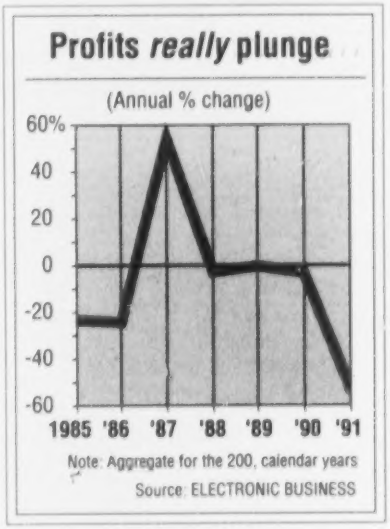
Poor financial performance last year was more than just the result of a mild recession and maturing industry. Fact is, the entire elec-

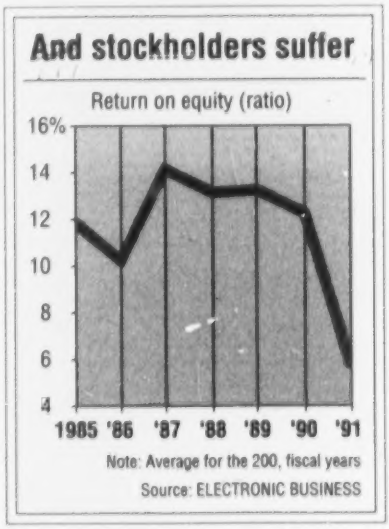
tronics industry has been coping with big changes. Digital Equipment and IBM may be struggling with the move toward open-standard systems, but the overriding challenge for many others on the 200 has been simply learning how to respond to their customers faster and more effectively. Technology no longer pushes sales the way it did in the '80s. While "customer satisfaction" and "customer focus" were favorite buzz phrases in last year's batch of annual reports, shifting from a technology-focus to a customer-focus takes much more than mere words.

Case in point: The globalization of the top 200 U.S.-owned electronics companies continues unabated. For every $1 in sales rung up by the average electronics company, foreign customers contributed over 34 cents to the till in fiscal 1991. For some, the stampede to foreign markets helped produce stellar results. Advanced Micro Devices increased its foreign sales 84% from fiscal 1990 to 1991 and Dell Computer raked in 73% more revenue from abroad. Even connector maker Molex, which made over 70% of its sales from overseas in 1990, managed to grow foreign sales a solid 27% last year.

For others, growing foreign sales hasn't been so easy. Nearly a quarter of the 200 saw foreign sales fall in fiscal 1991. From IBM, whose foreign sales inched downward 3.6%, to Integrated Device Technology, whose sales to Japan and Europe slumped 46%, the lesson is that having customers in another country is no panacea.







Even though the dismal data dominate, some positive statistics—capital spending, R&D, and debt—are hidden within the 200 database. They provide a glimmer of hope because these numbers represent an investment in the future.

Despite obvious pressures to deliver to the bottom line, the 200 maintained a fairly high level of capital spending. The ratio of capital expenditures to net cash flow after dividends jumped to 120 in fiscal 1991. This ratio indicates how the industry is using internally generated funds to support capital spending. A ratio below 100, where it had languished for five years, is considered bad news.

Although last year's swing in the ratio of capital spending to cash flow was due to a decrease in cash flow and *not* to an increase in capital spending, it is clear that electronics executives have been unwilling to jeopardize capital investments despite recessionary pressures. The real test, of course, will be how well capital spending holds up this year.

The top 200 companies devoted more resources to research and development as well. R&D costs as a share of revenue rose from 5.2% on average in fiscal 1990 to 5.5% in 1991. That's back on par with R&D costs in 1989. If U.S. companies are going to compete globally, much as stockholders may bemoan the lack of dividends, then this ratio will most likely have to rise even higher in the years ahead. One example is DSC Communications. In spite of its restructuring woes and the fact it experienced a sig-

Composite performance of the ELECTRONIC BUSINESS 200

Calendar years	1986	1987	1988	1989	1990	1991
Electronics sales ($ billions)	$279.2	$299.2	$327.7	$340.8	$362.3	$367.5
Total sales ($ billions)	$641.7	$689.7	$774.5	$814.9	$865.5	$876.4
Net profits ($ billions)	$26.7	$41.0	$39.7	$39.4	$38.0	$17.6
Fiscal years*	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Return on equity	10.2%	14.1%	13.1%	13.2%	12.2%	5.8%
Return on investment	7.2%	10.1%	7.2%	6.7%	5.7%	3.1%
Cost of goods sold/sales	63.7%	61.5%	58.6%	63.4%	60.8%	60.9%
R&D/sales	5.0%	5.2%	5.1%	5.5%	5.2%	5.5%
Sales per employee	$102,348	$113,533	$128,756	$133,941	$150,010	$157,106
Net profits per employee	$4,266	$6,662	$6,646	$6,761	$6,675	$3,334
5-year compounded annual growth rate:						
Sales	8.2%	10.7%	11.5%	7.7%	9.1%	7.9%
Net profit	4.0%	13.9%	8.3%	3.3%	5.4%	5.4%
Capital outlays to net cash flow after dividends	97.9%	73.9%	83.8%	95.0%	98.9%	120.4%
Debt to capital	29.9%	28.2%	45.3%	49.1%	53.2%	47.2%
Foreign sales/total sales	25.4%	24.9%	31.5%	32.3%	33.6%	34.3%

*Weighted average

Source: ELECTRONIC BUSINESS

nificant net loss last year, the company still managed to increase R&D spending 23% and R&D as a share of its revenue rose to 13.8%.

The industry's debt burden also improved significantly between fiscal 1990 and 1991. From a weighted average of over 53%, the debt-to-capital ratio for the top 200 dropped five points. Although this ratio is skewed—it includes debt carried by companies with substantial financing operations, such as Ford Motor and Westinghouse Electric—the median debt-to-capital ratio also fell. In 1990, half of the top 200 electronics companies had a debt ratio above 30.4%. Last year, the midpoint slipped to 27.2%. Two companies—Bolt, Beranek and Newman and International Rectifier—drew down debt faster than all others, from more than 67% and 87% of capital to 6% and 13%, respectively.

It's almost a mathematical law: As the electronics industry gets bigger, sales and profits growth are bound to slow. To make it onto the ELECTRONIC BUSINESS 200, a company had to make $204 million in revenue last year. In 1985, when IBM was a mere $50 billion company and before Sun Microsystems had gone public, the "entry fee" was only $123 million.

Despite the forces of maturation, the newcomers to the list add a dynamic, competitive edge. This year's new arrivals include five that enjoy the highest five-year compounded average growth rates: Zeos International (186%), SynOptics Communications (168%), Cabletron Systems (115%), Advanced Logic Research (109%), and Read-Rite (103%). Even more interesting, three old-timers continued to defy the laws of big numbers: Sun Microsystems, Oracle Systems, and Teradata (subsequently acquired by NCR) all clocked in with five-year growth rates over 70%. While the top 10 may falter again this year, look to the nimble newcomers to push 200 profits up again soon. □

This year's ELECTRONIC BUSINESS 200 is available on disk. For information, call (617) 558-4257.

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Sadly, 1991 was a great year to take write-offs

The list of companies that took huge one-time restructuring charges last year reads like a Who's Who of the electronics industry. Will the list get longer yet?

By Peter Burrows

ELECTRONIC BUSINESS 200 RESTRUCTURING

A lousy economy and rapidly changing business models forced many of ELECTRONIC BUSINESS's top 200 companies to bite the bullet on non-productive units and dead-end businesses last year. The big question is whether the worst is over, or if we are entering an era in which hefty restructuring charges become a familiar fact of life.

Consider 1991's frightening record. Bluechippers such as IBM, Digital Equipment, and National Semiconductor took huge one-time charges to downsize their work forces, refocus on core businesses, and adjust to the more open, services-heavy business models of the 1990s. Hotshots from the 1980s such as Compaq Computer, Apple Computer, and Mentor Graphics took one-time hits to bring their cost structures in line with the slower growth expected in the 1990s. Perennial restructurers such as Unisys, Wang Laboratories, Texas Instruments, and Control Data continued to lay-off employees, sell off assets, and scale back product lines.

Such restructuring contributed greatly to what was a thoroughly dismal year for the industry. In aggregate, the number of companies on the EB 200 list that lost money rose to 50 in 1991, from 37 the previous year. For the 36 pure-play electronics companies that made this losers list, total value of losses rose to $5 billion from $2.2 billion. The industry also shrank by 90,000 jobs, according to the American Electronics Association, making it the third straight year of decline.

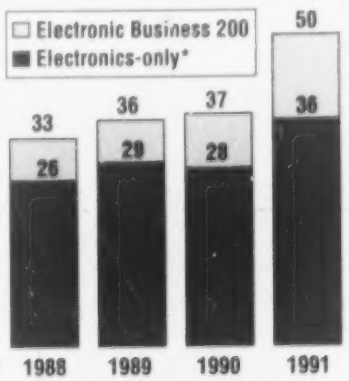
Most of the damage can be traced to the monstrous one-time charges taken by the large computer makers, including IBM's $3.4 billion, 29,000-person lay-off; $1 billion-plus charges from Unisys and DEC; and $100 million-plus write-offs from TI, Apple, Wang, Compaq, and National Semiconductor. In fact, the four top restructurers—IBM, DEC, Unisys, and TI—were responsible for 64% of the losses of pure-play electronics companies for the year.

The pain was not confined to the big boys, however. The broad, persistent recession compelled executives throughout the EB 200 to restructure. An example is Augat Corp., a $280 million supplier of interconnect products that took a $22 million charge to reduce its production capacity by 20% in 1991. "We've been running at about 60% capacity for some time, both because of the recession and because of the productivity gains we've been able to make, and we just don't see how that is going to improve in the next two or three years," says CEO Marcel Joseph.

One key problem is the worldwide nature of the recession: This time around, there has been no safety valve of overseas sales to prop up

The bottom line on 1991: From bad to worse

(Number of companies that lost money)



* EB200 companies that get 100% of revenues from electronics sales

Source: ELECTRONIC BUSINESS

struggling operations.

But the recession was not the only reason for the long list of restructurings in 1991, however. A number of pressures combined to make it an excellent year to cut one's losses:

• **Computer price wars.** Steadily falling prices for powerful microprocessors and memories and the emergence of high-volume, mass-distribution channels for computer sales sent tremors through an industry that has long been focused on high performance, proprietary technology, and direct sales. As the cumulative bite of the gnats in the second- and third-tiers of the industry began to draw real blood in 1991, industry leaders such as IBM, Compaq, and Apple were compelled to adjust and attack the low-end mass market—a strategy that requires new distribution strategies and much leaner cost structures.

Don't be surprised by continuing reports of billion-dollar write-offs

• **Accounting changes.** Many companies chose to come into compliance with the Financial Accounting Standards Board's standard No. 106, which requires companies to account for post-retirement benefits upfront rather than on a pay-as-you-go basis. This must be done by 1994 for U.S.-based operations and by 1996 for overseas operations. Although most companies will continue to pay actual dollars when the benefits are actually incurred, having to set aside a cash fund makes for a big hit to the balance sheet that Wall Street is unlikely to dismiss altogether. IBM, for example, had to take a $2.26 billion charge in the first quarter charge to satisfy this requirement.

• **Currency fluctuations.** The ups and downs of both the yen and the deutschemark in 1991 played havoc with finance departments, causing unexpected losses for some global U.S.-based companies. DEC, for example, claims it lost $150 million to $200 million in exchange-rate fluctuations alone.

Corporate psychology also played a role, some say. With bottom lines already in disarray, companies simply saw less downside to playing it straight with Wall Street. "Whether you take a charge of $100 million or $125 million, you're not going to earn any brownie points either way," says George Siboni, director of KPMG Peat Marwick's high-technology practice. "Once you've swallowed the bitter pill, you might as well cut deep enough to ensure you don't have to swallow it again any time soon."

Indeed, many companies seem to have cut deeper than was immediately necessary. DSC Communications, a $460 million communications maker in Plano, Tex., took a $48 million charge to reduce its work force by 20%—despite having the wherewithal to increase R&D spending by 18% in an effort to keep pace technologically through these difficult times.

But was it enough? With the weak recovery doing little to boost revenues or profits, many industry observers predict a continuing cycle of morale-draining, strategy-snuffing cutbacks.

Some examples of this already exist, especially among the industry's upper ranks. Saddled with sprawling, vertically oriented organization charts and high cost structures—and sometimes progressive no-layoff policies—

Biting the bullet–big time

	One-time charges ($ millions)	(% of 1991 sales)	Reductions in employment (employees)	(% decline from 1990*)
IBM	$3,400	5%	28,893	8%
Unisys	1,200	14	15,000	20
Digital Equipment	1,100	8	3,000	2
Texas Instruments	240	4	7,379	10
Apple	224	4	96	1
Wang	222	11	3,092	16
National Semiconductor	120	7	2,900	9
Compaq Computer	135	4	1,600	14
Western Digital	82	8	867	11
DSC Communications	48	10	781	19
Everex	36	8	596	23
Savin	33	11	864	42
Sprague	33	11	3,076	77
Mentor Graphics	27	7	309	15
Augat	22	8	NA	NA
Sequent	22	10	400	30

Fiscal year 1991 NA=Not applicable
* % of total work force

Source ELECTRONIC BUSINESS and company reports

companies such as IBM, DEC, and TI are struggling to get ahead of the downsizing curve. DEC, which perhaps best embodies this trend, has already announced its intention to take another $1 billion-plus charge and cut another 10,000 to 15,000 employees from its rolls in its fiscal 1992, even though it took a $1.1 billion charge and laid off 7,000 employees in fiscal 1991. (It added 4,000 employees due to an acquisition as well.) The company lost $404 million through the first three quarters of this year.

Top ten losses for 1992

($ millions)

Company	Net loss	Rank
Unisys	$1,393	9
Digital Equipment	864	4
IBM	564	1
Texas Instruments	409	10
Wang	373	40
National Semiconductor	150	44
DSC Communications	108	101
Savin	97	139
Western Digital	96	67
Borland International	75	110

Others, such as Control Data and Prime Computer, have gone a step further by deciding to once and for all end the vicious cycle of recurring restructuring that has plagued them over the past decade or so. Both recently took hefty charges to break off their older hardware units so as to focus more on their lucrative software and services divisions. Both companies are reportedly seeking investors to take these erstwhile names in computer history off their hands altogether.

There have, nonetheless, been some restructuring success stories. Unisys, for example, seems to have finally turned the corner after three straight years of $100 million-plus special charges. It enjoyed back-to-back profitable quarters for the first time since 1988 after taking a $1.2 billion charge last June, and has winnowed the $4 billion debt from the Sperry Corp. merger with Burroughs Corp. in 1986 down to less than $400 million at the end of 1991. Chief executive and chairman James Unruh expects the company to make money this year.

The company did this by setting 14 "turnaround teams" loose to find sources of cash and improve financial management. These teams generated over $1 billion in cash, CFO George Robson recently said, much of it through the sale of its Timeplex networking division, various real estate holdings, and other assets. All told, the company has slashed about 15,000 jobs, closed seven plants, and removed 20,000 items from its product catalog since late 1990.

National Semiconductor may be another success story in the making. The company took charges of $120 million in 1991 and $149 million in the first quarter of this year to consolidate its manufacturing and abandon certain cutthroat markets, such as high-speed SRAMs. Since then, it has strung together three quarters of profits. The $27.5 million profit in the fourth quarter ended May 31 was the company's best in five years.

Still, getting in front of the restructuring curve and staying there are two different things. "We believe strongly that you've got to get out in front and do some restructuring every day," Unisys's Unruh pointed out to financial analysts earlier this year. "Because the margins of our business . . . are going to continue to get thinner, we'd better stay in front of this reality and cut those costs."

Getting in front of the restructuring curve and staying there are two different things

AS A RESULT, don't be surprised by continuing reports of billion-dollar write-offs and three-, four- or five-digit layoffs. With profit margins shrinking and business models converging, the trend toward big one-time charges has certainly not yet run its course. "Our company has done all the restructuring I can foresee for the next four or five years," says Augat chief executive Joseph. "But many of our competitors and customers have yet to face reality, and it will take anywhere from 12 to 24 months for things to settle down."

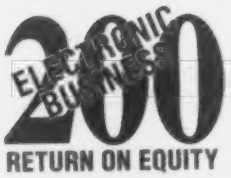
Indeed, if Joseph is correct, many electronics executives will be forced to learn more about the art of restructuring—a phase of management for which the industry has had limited experience.

"My most scathing indictment of the electronics industry is that they have very few older employees who have been through the whole roller-coaster ride," says Kathryn Rudie Harrigan, professor of strategic management at Columbia Business School. "By and large, the industry has ignored its bad times by laying off its older workers, but now it's in for a real cold shower." □

Recession, corporate restructurings claim ROE as a victim

For stockholders in the electronics industry, 1991 was the pits as sagging profits slashed return on equity

By Rick Whiting



Return on equity among the ELECTRONIC BUSINESS 200 plummeted to 5.8% in fiscal 1991 from 12.2% in fiscal 1990. The villains? **The recession, for one, which slashed the 200's total net profits by 54% to $17.6 billion, and the wave of corporate restructurings, which resulted in write-offs against earnings.**

A poor return on equity, or ROE—describing net income as a percentage of total equity—can depress stock prices, making it harder for companies to raise money through new stock offerings, and even making the company a tempting takeover target.

The good news is that observers expect ROE to rebound this year as the economy improves. After shedding thousands of employees and shutting down unprofitable operations, electronics companies are leaner and meaner and have lowered their break-even point.

"The economic recovery should show up even stronger in the ROE calculation," says Rick Martin, an analyst with The Chicago Corp. securities trading firm.

Sequent Computer Systems Inc., for example, saw its ROE drop from 9.7% to minus 32.6% in fiscal 1991 when the Beaverton, Ore., computer maker suffered a $48.7 million loss on a 14% drop in sales—much of that due to reduced sales to Unisys Corp., Sequent's major reseller. In response, Sequent cut about 25% of its 1,700 employees and took restructuring charges of $22.2 million. "Profitability is back on track, and we have every intention of getting our ROE back to where it was before," says Robert Gregg, CFO and treasurer.

At some companies, however, the restructurings and resulting slippage in ROE follow efforts to overhaul outdated corporate infrastructures, slash bloated payrolls, and stay competitive in the face of industry trends. Digital Equipment Corp., which took restructuring charges of $1.1 billion in fiscal 1991 as it closed plants and cut employees, saw its ROE drop from an already meager 0.9% in fiscal 1990 to negative 8.1% last year.

While old-guard companies such as DEC and IBM struggled with ROE in fiscal 1991, a new wave of companies in software, peripherals, and communications dominated the ELECTRONIC BUSINESS 200 ROE list. Microsoft Corp. and Borland International Inc. both came in with ROE above 30%, for example, as did disk-drive maker Quantum Corp. Read-Rite Corp., which develops thin-film components for disk drives, ended fiscal 1991 with an ROE of 51.2%.

In terms of ROE, fiscal 1991 was kinder to some segments of the electronics industry than others. Software companies did best among the ELECTRONIC BUSINESS 200, although the average 16.3% ROE was down from 19.0% the year before. PC and workstation vendors reported a respectable average 11.1% ROE, but not as good as the 21.9% ROE in 1990. Peripheral makers, on the other hand, saw their average ROE plunge from 16.3% in 1990 to a paltry 2.4%. And things only got worse for minicomputer manufacturers, whose average return on equity dropped from minus 7.2% in 1990 to minus 9.2% last year. □

Return on equity

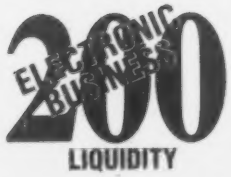
		200 rank
The top five		
Polaroid	88.5%	112
Read-Rite	51.2	192
Reliance Electric	50.7	105
Syntex	42.2	197
Microsoft	34.3	38
Median for the 200	9.1%	
The bottom five		
Emerson Radio	-1,335.1%	79
Wang Laboratories	-717.1	40
Tandon	-98.7	102
Archive	-94.4	130
Western Digital	-72.5	67

Source: ELECTRONIC BUSINESS

Corporate liquidity is crunched

Despite that, R&D spending probably won't slow

By Rick Whiting



Recessions are brutal on corporate liquidity. Inventories pile up as sales slow. Receivables stretch out as customers take longer to pay their bills. All the while, companies continue to burn cash unless expenses are quickly brought to heel. Liquidity for the ELECTRONIC BUSINESS 200, as measured by the ratio of current assets to current liabilities, averaged 1.44 in fiscal 1991, a relatively poor performance given that most analysts consider 2-to-1 a healthy "current ratio." These statistics include auto makers and companies with financial service and credit operations, which skews the liquidity picture.

Companies facing a liquidity crunch often delay capital equipment purchases, take longer to pay their bills, and cut spending for research and development, effectively mortgaging the company's own future. Last year, capital spending by the top 200 did decrease slightly while R&D as a percentage of sales actually increased.

The recession strained the liquidity of even financially strong companies. Despite a 27% sales increase in fiscal 1991, Cypress Semiconductor Corp.'s liquidity ratio slipped to 3.45 from 3.63 a year earlier when the sluggish economy slowed the San Jose chip maker's sales growth in the second half of the year. Although 3Com Corp. of Santa Clara, Calif., reported a respectable 3.05 current ratio for fiscal 1991, that was off from the previous year's 3.89 because of a 5% dip in 1991 sales.

Not all the liquidity problems could be blamed on the recession. Some suffered as they fought to adjust to long-term changes in the industry. For example, IBM's current liabilities increased to $33.6 billion from $25.3 billion a year earlier. Big Blue's 1991 current ratio dropped to a poor 1.22 from a mediocre 1.54 a year earlier.

MAI Systems Corp. was dead last on the ELECTRONIC BUSINESS 200 liquidity list with a current ratio of 0.41, down from 1.03 in fiscal 1990. MAI Systems is struggling to shift from manufacturing proprietary minicomputers to reselling and integrating industry-standard hardware and software, a battle not made any easier by the recession and the Tustin, Calif., company's huge debt burden. The company's cash reserves shrank from $12.3 million to $9 million in fiscal 1991, and its current liabilities ballooned from $178 million to $300 million.

Despite the lean year, Cabletron Systems Inc., a Rochester, N.H., vendor of data communications equipment, topped the 200 liquidity list with a 9.51 current ratio. Thanks to 72% sales growth to $180.5 million, and a secondary stock offering, Cabletron more than doubled its cash horde to $33 million in fiscal 1991.

Through operations and new public offerings, Conner Peripherals Inc. built up $570 million in cash by the end of fiscal 1991 (ended Dec. 31) and listed total current assets at more than $1.1 billion. The result is a very impressive 6.65 liquidity ratio.

That said, high liquidity can also turn a company into an attractive takeover target. Because most companies in the ELECTRONIC BUSINESS 200 with high current ratios also have high stock prices, they aren't very vulnerable. Conversely, companies with lots of cash and low stock prices—DEC, for instance, with about $1.9 billion in cash reserves—have much to fear from hostile takeover artists. □

Where the cash is

Current ratios by industry segment	
Distributors	3.90
Communications	3.16
Software	2.75
Consumer	2.65
Desktop	2.64
Peripherals	2.61
Components	2.28
Government	2.23
Semiconductors	2.20
Mainframes	2.18
Minicomputers	2.06
Instruments	1.90

Source: ELECTRONIC BUSINESS

Is the industry growing foreign sales fast enough?

Even though global marketing can reduce a company's risk, only half of the 200 derive a third or more of their revenue from overseas

By Barbara Jorgensen

Datapoint Corp. takes its overseas sales seriously. In 1991, so much of its revenue was derived from Europe that it moved its primary executive headquarters to Paris. Although Datapoint's overall sales fell slightly in 1991, its European sales grew by 10%.

With 94.4% of its total revenue coming from offshore—a higher percentage than any other company in this year's ELECTRONIC BUSINESS 200—San Antonio, Tex.-based Datapoint is anything but typical. The weighted average for the ELECTRONIC BUSINESS 200 was 34.3% in 1991, up from 1990's 33.6%. That reflects a steady climb in foreign sales for the aggregate 200. In 1985, a mere 14% of the EB 200's sales came from offshore.

Sounds as if the electronics marketplace is getting pretty global, right? Nope. Barely half of the EB 200—107 companies, to be exact—derive one-third or more of their sales from foreign markets. Of the remaining 93, 24 either don't sell overseas or sell so little they don't even have to report it.

"I think that if [U.S.] companies hope to survive the next 25 years, they'll *have* to take a global look at the marketplace. Those that do not adapt globally will not survive." That warning comes from Fred Krehbiel, CEO of connector manufacturer Molex Inc., a company that knows a thing or two about foreign sales. Molex's sales split between the U.S./Europe (45%) and Asia (55%) helped the company grow 19% in a world connector market that grew only 4.3% last year. Molex is one of a handful of U.S. companies with more sales to Japan than to the U.S.

IBM generated the most dollars in foreign sales—$40 billion—and ranked #1 in terms of dollar value. But the company ranked #13 in terms of the ratio of foreign sales to total sales—62.3%. At the bottom of the list are many non-manufacturing companies—distributors, for example. That's likely to change by next year's EB 200: U.S. distribution leaders Avnet Inc. and Arrow Inc. announced in 1991 they expanded into Europe, either by investing in or buying European distributors.

Companies that can't adapt globally won't survive, warns Molex's Fred Krehbiel

Of the five EB 200 companies with the highest percentages of foreign sales, most were able to offset slow U.S. sales in 1991 with growth in foreign markets. CIM developer Measurex Corp. (68.4%), for example (which was not among last year's top five), reported a slowdown in Sweden, the U.K., and Germany, but saw sales improve in the Pacific Rim. "If a company is to be a leader in its niche," says Measurex communications director Carol Wilson, "it must serve all the potential customers it can reach. For Measurex, development of overseas markets is an important form of diversification that reduces risk."

Three of the top five in foreign sales—Datapoint, Molex, and Measurex—spread their risks pretty successfully in 1991. Datapoint displaced Tandon Corp. (78.6% this year)

as the top foreign seller. Molex's percentage of foreign sales grew from 71.1% in 1990 to 75.8%, and Measurex displaced Micropolis (66.6%), one of last year's top-five companies.

But don't pack for Europe yet: Tandon also derives most of its sales from Europe, and the PC maker's European sales dropped by 11%. Overall sales were up 5%, but Tandon is feeling the effects of desktop, laptop, and notebook pricing pressure, particularly from Asian competition. Datapoint, a networking systems company, is riding the wave of a networking boom in its four main areas: information processing, personal computing, telephone services, and videoconferencing.

Both Measurex and Molex entered foreign markets in the early 1970s, a period during which Krehbiel says it was easier to enter Japan. (As Krehbiel tells it, that was around the same time his father told him he wasn't making enough of a contribution to the company and dispatched him overseas.) In 1970, Measurex determined that two-thirds of its primary end-market, paper and pulp manufacturing, was offshore. Its first two sales were in the U.K. and Finland. The company sold its first system to Japan in 1973.

Measurex and Molex agree on the first tenet of overseas manufacturing, whether it's in Europe or Japan: Establish a local presence in the targeted market and hire nationals to run the business.

Molex's entree into Japan began as a joint venture. Two years later, it was a wholly owned subsidiary managed by Japanese employees. "We wanted to run [Molex Japan] like a Japanese company, and not burden our local managers with our way of doing business," says Krehbiel.

The second piece of advice, says Krehbiel: Don't force-feed your product to the marketplace. Study what your customers need and deliver exactly that. For Molex, that meant developing miniature connectors for Japan's consumer marketplace before that trend reached the United States. When U.S.-made computers and peripherals began to get smaller, Molex had a head start. The company also was able to introduce CIM to its Japanese manufacturing operations and leverage its telecom expertise from its European customers into other markets.

Next, take a long-term view and realize success will not happen overnight. Molex and Measurex have been operating in foreign markets for more than two decades. "Be prepared to invest time and effort," says Krehbiel, "and you're going to have a good shot it. We've had major Japanese corporations doing business with us for 22 years."

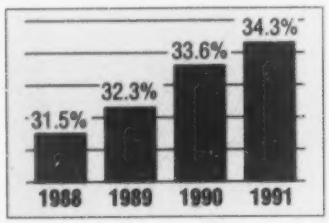
The importance of balance can't be overemphasized, although Krehbiel claims Molex didn't start out to capture 54.9% of its sales from the Far East, 27.1% from the Americas, and 17.5% from Europe. Balance, he says, developed along with the connector market. "The U.S. is the biggest market, with Europe and Japan a close second. You should have a good balance as long as it reflects the market. You can't just target 25% of your sales from outside the U.S. if the market won't support it."

Measurex's sales breakdown is similar: 44% from Europe, 31% from the Americas, and 25% from the rest of the world. "When the U.S. paper industry started into its recession about two and a half years ago, our European market was doing well," says Wilson. "Now, when the U.S. is beginning to recover, Europe is having a downturn. These fluctuations balance our performance and help us avoid drastic drops in revenue during hard times."

Last, advises Krehbiel, be prepared to deal with your global customers at their headquarters and design centers, particularly when discussing supply relationships and specialty products. "You have to deal with them locally, where their factories are, on a day-to-day and servicing basis." □

Foreign/total sales

(Ratio)



Average for the 200		200 rank
The top five		
Datapoint	94.4%	166
Atari	86.1%	165
Tandon	78.6%	102
Molex	75.8%	81
Measurex	68.4%	169
Median for the 200	36.0%	
The five most improved		
Advanced Micro Devices	83.7%	55
Dell Computer	72.7%	70
Microsoft	62.5%	38
Silicon Graphics	59.2%	87
Conner Peripherals	55.3%	45

• % change in foreign sales, fiscal 1990 to 1991; excludes companies that made major acquisitions.

Excludes companies with no foreign sales

Source: ELECTRONIC BUSINESS

How reliable are those productivity numbers?

The figures reported to the public are so riddled with nuances that companies can make the data mean almost anything

By E. B. Baatz

For many of the top 200 largest U.S. electronics companies last year, eking out productivity gains was a painful process. Average productivity for the bunch rose a meager 4.7% in fiscal 1991, far from the stellar 12% gain of the year before. The key to last year's productivity gain was a 4.4% drop in employment. More than half of the companies cut their payrolls, which left only 5.5 million people employed by the top 200 in 1991. That's down 23% from 1985, when the top 200 largest electronics companies employed 7.1 million people.

The median productivity figure for the top 200 stood at $137,000 last year; half were higher and half were lower. At the top, with a mind-boggling $1 million-plus in revenue per employee, stands computer and software distributor Merisel Inc. of El Segundo, Calif. On the bottom, with $45,000, is magnetic recording head manufacturer Applied Magnetics Corp. of Goleta, Calif.

It's logical to conjecture that Merisel must be one heck of a company and that Applied Magnetics must be in big trouble. That notion, however, begs the question: What do comparisons of revenue per employee really mean? The answer, say many, is "not necessarily much."

"CFOs in particular get quite skittish showing revenue per employee," says Margaret Epperheimer, vice president of corporate services for The Ask Companies in Mountain View, Calif. "This number is far more complex than one would want it to be."

Exactly how employment and revenue get calculated is one infuriating problem. It's so arbitrary, in fact, the method chosen may vary from year to year even within the same company. For example, some companies report head count at year-end while others report average employment for the entire year. In a growing company, the latter will yield a higher productivity figure.

How revenue gets reported by the bean counters can tangle the productivity equation, too. Suppose a company buys a box for $80,000 and resells it for $100,000. The company may add only the net $20,000 to its top revenue line. Or it may choose to report the entire $100,000 on its top line and deduct $80,000 on its cost line. Either way, the bottom line doesn't change, but productivity will be inflated in the latter case.

Furthermore, productivity comparisons of companies even in similar market segments can be misleading because some contract out labor-intensive business functions while others do not. "We do the whole nine yards: design, develop, manufacture, sell, and service," says Richard Egan, chairman of storage product maker EMC Corp. in Hopkinton, Mass. Comparing EMC to companies that use contract manufacturers and distributors isn't exactly fair. The same goes for Wyle Laboratories Inc. of El Segundo, Calif., a distributor that has a separate defense R&D division. That scientist-laden division drags down Wyle's revenue per employee and skews comparisons against other pure-play distributors.

"I don't get too excited that we're second best [in peripherals]... says William Marriner, senior vice president

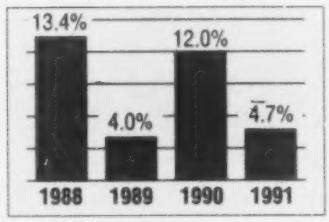
Even the most productive companies' finance officers caution against placing too much emphasis on revenue per employee.

"I don't get too excited that we're second best [in the peripherals category]. It depends on the structure of your business, so you can't look at revenue per employee and say you're better or worse," agrees William Marriner, senior vice president of finance and administration for tape drive maker Exabyte Corp. of Boulder, Col.

Two other subtle distinctions make intercompany comparisons tough. One must ask where a company is in its product development stage-and in its acquisition stage. For example, a company that is investing heavily in labor during the early stages of product development looks temporarily bad in a productivity snapshot. Also, a company that makes an acquisition and quickly cuts redundant functions such as accounting and corporate support services will get a sudden jump in productivity. Or if the acquisition is made late in the year and the cuts aren't made before the year-end employee count is reported, the acquisitions may make a company's productivity numbers look temporarily low.

Sales per employee

(Annual % change)



Average for the 200

The top five		200 rank
Merisel	$1,093,400	46
Tech Data	937,600	86
Emerson Radio	929,700	79
Anthem Electronics	694,800	113
Quantum	607,400	60
Median for the 200	$137,000	
The five most improved*		
Storage Technology	25.2%	58
Solectron	21.7	137
Symbol Technologies	20.2	136
Sun Microsystems	20.1	20
Intel	18.4	14

* % change, fiscal 1990 to 1991, includes only companies that increased employment

Source: ELECTRONIC BUSINESS

Although cautious about comparisons with others, most finance officers in the electronics industry do rely on the revenue-per-employee figure as an internal measure. "We use it as a head-count management tool and I look at the number very closely every three months," says Exabyte's Marriner. There's plenty of room for cheating, however. "We have a tendency to use the revenue-per-employee number when it's good. When it's not, we don't," says one source.

Many rely on more sophisticated measures of corporate productivity, although these yardsticks aren't readily available to the public. And for executives who answer to the sound of ticker tape on Wall Street, profits per employee are even more important than revenue.

"Revenue per employee is not the final answer. Use the numbers as a guideline or benchmark, but you have to analyze and rationalize them," warns Leonard J. LeBlanc, chief financial officer for Cadence Design Systems Inc. No one said it was going to be easy. □

Here's another way to count those beans

Gilbert F. Amelio, president and chief executive officer for National Semiconductor Corp., offers an alternative measure of corporate productivity.

Q: You don't think much of the revenue-per-employee measure of productivity. What measure do you use at National Semiconductor?

A: I finally decided the only valid way to measure productivity was to look at value added. Specifically, we take sales, subtract purchased materials, and divide by employee payroll.

Q: The value-added concept makes sense, but why do you use payroll data?

A: Using employee payroll instead of head count corrects for different international pay scales. For example, we make diodes in the Philippines. When you factor in that operation, you add a lot of people [because it's more labor intensive] and it doesn't look very productive.

Q: How do the value-added numbers work out?

A: For every $1 we paid in payroll we produced a little more than $2 in value. The range for a typical manufacturing company is 1:2 to 1:3. A ratio of 1:3 is world class, so we could do a little bit better. □

Going back to basics pays off for Varian

Net profits at the diversified company rose 356% last year, but CEO Tracy O'Rourke says there's still a long way to go

By Barbara Jorgensen

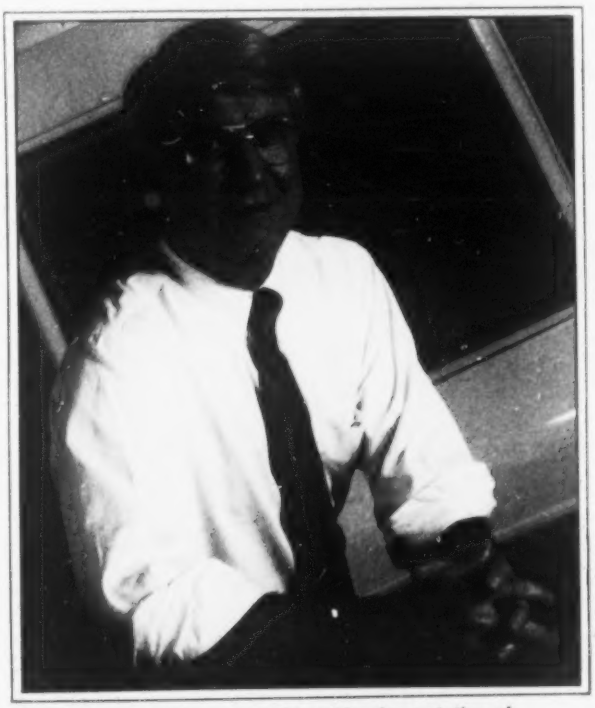
VarianAssociates' CEO J. Tracy O'Rourke shrugs off some of his profit-netting restructuring methods as "textbook." And some of them are. Divesting the instrument and equipment maker of its unprofitable operations, trimming employee rosters, and improving manufacturing efficiency is pretty much standard operating procedure in cutting costs. Still, O'Rourke and his management team implemented some specific employee and customer programs that helped make Varian, which was ranked #50 on this year's ELECTRONIC BUSINESS 200, also the most-improved large company of the list.

O'Rourke is the first to point out that fiscal 1990 included a $52 million restructuring charge that skews 1991's results a bit. Nonetheless, Varian's net profits rose by 356.4% during fiscal year 1991, ended Sept. 30, to $57.5 million, up from $12.6 million in 1990. Profits were 4.2% on sales of $1.4 billion, up from 1% in 1990. The company's 1991 ROE came in at 13.2%, compared with an average of 5.8% for this year's 200.

Palo Alto-based Varian is about halfway through a three-phase program that O'Rourke hopes will eventually produce a consistent 10% return on sales, which has ranged between 1% and 4% for a number of years.

Although the company has been profitable for eight out of the last 10 years, when O'Rourke replaced retiring chairman and CEO Thomas Sege in February 1990, Varian had been losing its edge because of slow product development and inefficient manufacturing practices. The company had also been force-feeding its latest technology to customers that didn't need it. And Varian had over-diversified, distracting it from its core businesses.

The first phase, completed in fiscal '91, included selling 11 of Varian's divisions or product lines for some $60 million. Of the four remaining businesses—semiconductor production equipment, analytical instruments, electron devices, and medical equipment—all but electron devices saw sales growth last year.



Christopher Springmann

"We often targeted our own elegant implementation of technology," admits Varian CEO Tracy O'Rourke

The second phase is what O'Rourke calls establishing "organizational excellence," a focus on internal improvement through quality, customer satisfaction, faster time-to-market, and flexible factories. Each, either through cost-savings or improved sales, has improved Varian's bottom line.

Achieving faster time-to-market involved a lot of interrelated procedures: culture change, "modern" manufacturing, and employee empowerment. An ingrained culture that fostered a "late is OK" attitude, combined with inefficient manufacturing, had Varian shipping product up to 9 months past the promised date.

Speed and reaction time were put at the top of everybody's list. Quality training was stepped up. Varian management also sought employee suggestions on what customers wanted, and they were empowered to respond. "People always wanted to be told what to do, and if someone wasn't there to do that, nothing would happen," notes O'Rourke. "We had to work on empowering our employees to make decisions."

One such scenario was worked out at Varian's Medical Equipment group. The unit's president, Tim Guertin, and the quality improvement team drew up a model for gauging improvement in process, products, and personnel. "Everyone must know what, when, and how much to do," says Guertin. "Even more crucial, they all must agree." Early results: The unit's average score on its measurement scale rose from 3.2 to 3.6 on a scale of one to five.

At the same time, layers of management were eliminated. "In one of our divisions we had four to five layers of management between the 'hands-on' guy and highest management," says O'Rourke. "We've reduced that to two." That, combined with other company-wide efficiency programs, helped sales per employee for the entire company to go from roughly $124,000 to $148,000.

Within Varian's manufacturing operations, poor planning meant excess, obsolete, or unusable inventory. "We were throwing away two to three times what an efficient company would throw away," O'Rourke says. Excess and obsolete inventory were discarded, saving warehouse space and personnel to maintain, move, and store it. Just-in-time (JIT) delivery and supplier qualification programs ensured the quality of incoming inventory and cut scrap and assembly-line rework.

Varian also moved to outsource operations such as machining and metal fabrication that formerly were done in-house. "Varian was doing about 50% internal sourcing," says O'Rourke. "We're way below that now."

One example of the programs' combined success is the Varian Medical Equipment facility in the U.K. Varian found that JIT, vendor qualification, and waste-elimination increased plant output by 20%. Eliminating non-value-added tasks—outgoing inspection and checking data entry—gained a 15% reduction in factory floor space and 60% in assembly time.

Cost savings don't come painlessly, and Varian's staff reductions hurt morale. Peak employment at Varian, explains O'Rourke, was 12,400; most recently, that was down to 8,400. Some 1,600 employees left with the divested businesses. Some were economy-related reductions, and 1,200 were due to efficiency gains. To keep morale up, says O'Rourke, "We over-communicated to our employees and were very candid. You can't mislead your employees—they know a lot more about what's going on than you think."

In addition to communication on staff reduction, O'Rourke and his management team try to illustrate their commitment to organizational excellence. In the past 18 months, they made 34 visits to Varian's 20 sites worldwide. "It's not an audit—it's a visit," stresses O'Rourke. Employees are encouraged to share ideas and talk about efficiencies while manage-

Varian at a glance

Fiscal year ended Sept. 30	1991	1990
Sales (millions)	$1,378	$1,265
Net income (millions)	$57.5	$12.6
Net income/ sales	4.2%	1.0%
Cost of goods/sales	64.0%	65.7%
R&D/sales	6.0%	6.1%
Marketing, G&A/sales	19.6%	18.3%
Number of employees	9,300	10,200
Sales per employee	$148,162	$124,004
Net income per employee	$6,183	$1,235
Capital expenditures/sales	4.3%	4.3%
Current ratio	1.70	1.64
Debt/equity ratio	0.16	0.19
Foreign sales/sales	46.2%	41.5%
Six months ended Mar. 31	**1992**	**1991**
Sales (millions)	$619	$676
Net income (millions)	$15	$28

Source: Company reports

ment works on building confidence. "They are bombarded with success stories," says O'Rourke. One involved a semiconductor equipment division that shipped half its deliveries late to customer Intel in Aloha, Ore. Varian's customer service rep formed a work-out team and with Intel, kept tabs on order requirements, parts availability, and shipping schedules to help flag potential problems. Within a month, deliveries were 100% on time.

Improving internal operations is one thing; pleasing the customer is another. "In too many cases, our product was off target," says O'Rourke. "We often targeted not what the market needed but our own elegant implementation of technology, which added cost." In one case, a sputtering-system customer complained that replacing the system's protective shields took 24 hours, so a Varian sales rep worked with the customer on a redesign. The shields now can be changed in six hours.

Varian has also tried to remove the mystery from many of its machines. A High Point, N.C., lab uses a Varian gas chromatograph (GC) to monitor toxins in water supplies. With the help of his Varian sales rep, Bill Frazier adapted the GC to not just identify but "fingerprint" the sources of pollutants. "Between [the rep], the state, and me, we came up with some intuitive designs, and within four weeks, we were able to prove [a local business] was part of the toxicity problem," says Frazier.

Another important lesson for Varian, says O'Rourke, was to recognize a shift in the buying influence among Varian customers. Using "won-business" and "lost-business" surveys, the company realized that, while salespeople were trained to work with users, "they couldn't talk the same language as the people who signed the check." The sales force is now working to become more adept at explaining Varian products to nontechnical decision makers.

Varian has accomplished a lot in a year, but O'Rourke stresses the job isn't done yet. The third phase, he says, will establish "respectable and consistent" profitability and accelerate growth. How? "We've been hovering around 4% [profit on sales], and we have a multibusiness enterprise," O'Rourke explains. "So, we look at each business and benchmark it against the best in class. You weigh that and come up with something reasonable. For us, that should be 10% return on sales." □

The "most-improved" large and small companies (more and less than $1 billion in revenue) were chosen with a combination of criteria including change in profits, productivity, debt-to-capital ratio, R&D-to-sales ratio, and other financial data between 1990 and 1991.

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Tough acquisition was worth it for Symbol Technologies

New products and buoyant market helped increase sales 38% and boost net earnings by 201%

By Dwight B. Davis

After several years of strong growth, Symbol Technologies Inc. sputtered in 1990 when sales for the bar-code scanner manufacturer grew just 4.1%, to $231.5 million. The big reason was trouble digesting its late-1988 acquisition of portable-terminal vendor MSI Data, whose products weren't as good or market position as strong as Symbol first believed.

1991 was far better. A product-line re-vamp, continued strength in bar scanners, and solid financial controls helped Symbol push sales up 38%, to $319.4 million. That wasn't even the best news. Net earnings grew 201% in 1991, to a record $22.8 million. Return on assets, return on investment, and return on equity all more than doubled from year to year, and sales per employee rose from $120,823 to $145,172 while Symbol's head count grew from 1,916 people in 1990 to 2,200 by 1991. No other electronics company under $1 billion in sales could match the Bohemia, N.Y., company's overall improvement during yet another recession-plagued year.

The overall bar-code scanning marketplace has traditionally grown at an impressive 20% to 30% per year, says Symbol president Raymond Martino. Symbol rose with that market after pioneering the hand-held laser-scanner sector. Currently, the company holds about 85% to 90% of the hand-held laser sector, estimates Walter J. Winnitzki, an analyst with Brown Brothers Harriman & Co. in New York.

Symbol's scanners were first snapped up by the top-tier, non-food retailers during the 1980s, but by the end of the decade, that market was becoming saturated. Symbol began to refocus its marketing efforts toward midsize retailers and new markets. One move was the acquisition of MSI Data, a leader in the hand-held computer terminal business. Symbol management hoped to marry portable scanning devices with portable data terminals (PDTs).

But instead of giving Symbol easy entry into a new market, the company found itself completely reworking the MSI Data product line. "We didn't realize MSI Data's product line was

Symbol Technologies at a glance

Fiscal year ended Dec. 31	1991	1990
Sales (thousands)	$319,376	$231,496
Net income (thousands)	$22,768	$7,576
Net income/ sales	7.1%	3.3%
Cost of goods/sales	44.2%	43.8%
R&D/sales	8.5%	9.5%
Marketing, G&A/sales	30.6%	35.0%
Number of employees	2,200	1,916
Sales per employee	$145,172	$120,823
Net income per employee	$10,349	$3,954
Capital expenditures/sales	5.4%	6.6%
Current ratio	3.55	3.12
Debt/equity ratio	0.09	0.11
Foreign sales/sales	29.7%	31.7%
Three months ended Mar. 31	**1992**	**1991**
Sales (thousands)	$89,043	$70,578
Net income (thousands)	$5,491	$4,115

Source: Company reports

"We didn't realize MSI Data's product line was as weak as it was," says Symbol president Martino

as weak as it was," admits Martino. "We actually lost market share in PDTs during that [1989-90] period."

At the same time Symbol struggled to update MSI Data's products, they had to "re-invent ourselves from being a plug-and-play peripherals company to being a systems company that sold [complete systems] as well as [software] applications," says Martino. Reshaping Symbol and absorbing MSI Data also involved a certain amount of culture shock. "We were 98% hardware, and 80% of the people we hired as part of the acquisition were software personnel."

By late 1990, the gamble started to pay off. Not only did Symbol improve MSI Data's existing products, but also it was the first manufacturer to integrate laser scanners into PDTs. The company also developed a wireless communications option called Spectrum One that permits immediate updating of computer databases from information scanned on the store, warehouse, or factory floor.

Tackling these ambitious projects was possible largely because of Symbol's strong fiscal position, says chief financial officer Thomas Amato. "Although we are aggressive in the marketplace and in product development, we maintain a very conservative financial strategy," he adds. "In 1990, we had virtually no debt and a good cash position, so nobody told us to slow down our product development work."

New products began to boost the bottom line in a big way in late 1991 and early 1992:

- The U.S. Postal Service ordered 10,000 integrated scanning terminals from a Symbol systems integrator, Systemhouse Inc. in Arlington, Va.
- K mart Corp. standardized on Spectrum One in its more than 2,000 stores. By June of this year, Symbol had installed wireless systems at more than 1,000 K mart sites.
- JC Penny ordered 38,000 hand-held scanners for use at its point-of-sale locations.
- United Parcel Service will outfit each of its 60,000 drivers with a Symbol hand-held scanner.

A strong patent portfolio has further buttressed Symbol's success. Following recent court battles over patents, virtually all of its competitors have signed licensing agreements with the company.

Early this year, Symbol lost a hotly contested bid to competitor Telxon to supply Wal-Mart with integrated terminals and a wireless communications network. But, notes analyst Winnitzki, Telxon will pay Symbol a 7.5% royalty payment for all the integrated scanning terminals it sells. "Because of [Telxon's] aggressive pricing, Symbol should earn almost as much through royalty payments from Telxon as it would had it won the award outright," he says.

Symbol's strategy has always been to license its patents rather than hoard them for its own use. "We aren't large enough to spread the laser-scanning technology on our own. We license our patents to strong companies that we think will help expand the market," Martino says. "We think we're good enough to win our share of business against our licensees."

Increasingly, that business is overseas. European sales accounted for about 30% of Symbol's 1991 revenue, a market with great growth potential, according to Amato. Japan and other Asian countries have already invested heavily in bar-code systems based on charge coupled device (CCD), not laser, technology. It's unclear if Symbol can penetrate that market, but it has established a joint marketing and manufacturing venture with Olympus Optical Co. in Japan to attack applications in which laser scanners out-perform the CCD competition. Symbol will get a 10% royalty on any systems the Japan plant manufactures and sells. □

The "most-improved" large and small companies (more and less than $1 billion in revenue) were chosen with a combination of criteria including change in profits, productivity, debt-to-capital ratio, R&D-to-sales ratio, and other financial data between 1990 and 1991.

How Symbol's sales will change

($ millions)

	1990	1991	1992	1993
Laser scanners and modules	$136.5	$186.0	$214.5	$252.0
Portable terminals and systems	$71.0	$105.0	$143.0	$171.0
Service and other	$24.0	$28.4	$32.5	$37.0
Total	$231.5	$319.4	$390.0	$460.0
Sales growth (% change)	4.1%	38.0%	22.1%	17.9%

Note: Portable terminals and systems includes sales of laser modules in integrated terminals systems
Source: Brown Brothers Harriman & Co

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FINANCIAL TABLES

Rank 1991	Rank 1990	Company Location	Calendar year 1991 Electronics sales ($ millions)	Total sales ($ millions)	Net profits ($ millions)	Profits as a percentage of sales	Fiscal year 1991 Return on assets	Return on equity	Return on investment
1	1	**IBM** Armonk,N.Y.	$64,792	$64,792.0	$-564.0	-0.9%	-0.6%	-1.5%	-0.9%
2	2	**AT&T** New York,N.Y.	22900	63089.0	522.0	0.8	1.0	3.2	1.6
3	4	**Hewlett-Packard** Palo Alto,Calif.	14949	14949.0	856.0	5.7	6.3	10.4	8.7
4	5	**Digital Equipment** Maynard,Mass.	14238	14238.0	-864.0	-6.1	-5.2	-8.1	-7.9
5	3	**Xerox*** Stamford,Conn.	13819	13819.0	436.0	3.2	5.7	NA	NA
6	6	**GM Hughes Electronics** Detroit,Mich.	11541	11540.6	381.1	3.3	2.9	4.6	4.2
7	7	**Motorola** Schaumburg,Ill.	11341	11341.0	454.0	4.0	4.8	9.8	7.1
8	9	**General Electric** Fairfield,Conn.	9530	60236.0	4435.0	7.4	2.6	20.5	4.6
9	8	**Unisys** Blue Bell,Pa.	8696	8696.1	-1393.3	-16.0	-16.5	-69.2	-26.3
10	10	**Texas Instruments** Dallas,Tex.	6784	6784.0	-409.0	-6.0	-8.2	-20.9	-14.2
11	13	**Apple Computer** Cupertino,Calif.	6496	6496.0	325.4	5.0	8.9	17.5	16.2
12	11	**Honeywell** Minneapolis,Minn.	6193	6192.9	331.1	5.3	6.9	18.0	12.5
13	14	**Raytheon** Lexington,Mass.	5501	9274.2	591.8	6.4	8.1	14.8	11.0
14	18	**Intel** Santa Clara,Calif.	4779	4778.6	818.6	17.1	13.0	18.5	16.5
15	15	**Rockwell International** El Segundo,Calif.	4524	11549.5	582.3	5.0	6.3	14.2	11.5
16	16	**Tandy** Ft. Worth,Tex.	4515	4514.7	176.2	3.9	6.7	11.2	8.4
17	17	**Eastman Kodak** Rochester,N.Y.	3968	19419.0	17.0	0.1	0.1	0.3	0.1
18	19	**Lockheed** Calabasas,Calif.	3830	9809.0	308.0	3.1	4.7	12.3	7.4
19	21	**3M** St. Paul,Minn.	3500	13340.0	1154.0	8.7	10.4	18.3	14.9
20	30	**Sun Microsystems** Mountain View,Calif.	3455	3454.7	199.3	5.8	8.2	15.7	11.6
21	31	**Seagate Technology** Scotts Valley,Calif.	3372	3372.1	73.9	2.2	3.3	8.2	5.3
22	20	**Compaq Computer** Houston,Tex.	3271	3271.4	130.9	4.0	4.6	6.8	6.5
23	23	**Westinghouse Electric** Pittsburgh,Pa.	3245	12794.0	-1086.0	-8.5	-5.4	-29.0	-14.3
24	24	**Litton Industries** Beverly Hills,Calif.	3076	5463.5	68.4	1.3	1.3	5.5	4.4
25	26	**Martin Marietta** Bethesda,Md.	3025	6075.4	313.1	5.2	8.0	17.4	12.7
26	25	**Harris** Melbourne,Fla.	3017	3017.1	89.7	3.0	0.8	1.9	1.1
27	42	**Loral** New York,N.Y.	2870	2870.1	112.1	3.9	3.6	13.4	6.1
28	27	**TRW** Cleveland,Ohio	2800	7913.0	-140.0	-1.8	-2.5	-8.3	-4.2
29	29	**Allied-Signal** Morristown,N.J.	2775	11831.0	-273.0	-2.3	-2.6	-9.2	-4.7
30	34	**GTE** Stamford,Conn.	2643	19621.0	1529.0	7.8	3.6	13.5	5.2
31	33	**AMP** Harrisburg,Pa.	2631	3095.0	259.7	8.4	8.6	13.6	11.3
32	28	**ITT** New York,N.Y.	2525	20421.0	817.0	4.0	1.5	8.9	4.2
33	22	**Ford Motor** Dearborn,Mich.	2510	92055.4	-2258.0	-2.5	-1.3	-10.0	-7.1
34	35	**DuPont** Wilmington,Del.	2500	38695.0	1403.0	3.6	3.9	8.4	5.6
35	32	**Boeing** Seattle,Wash.	2470	29314.0	1567.0	5.3	9.9	19.4	16.7
36	36	**Emerson Electric** St. Louis,Mo.	2434	7443.4	637.7	8.6	9.9	19.4	14.1
37	38	**Pitney Bowes** Stamford,Conn.	2353	3332.5	287.9	8.6	4.5	16.0	6.0
38	47	**Microsoft** Redmond,Wash.	2275	2275.9	584.4	25.7	28.1	34.3	34.3
39	45	**E-Systems** Dallas,Tex.	1991	1991.3	109.5	5.5	10.2	14.6	13.0
40	37	**Wang Laboratories** Lowell,Mass.	1944	1944.0	-373.4	-19.2	-26.7	-717.1	-65.1
41	41	**Tandem Computers** Cupertino,Calif.	1933	1932.9	-52.4	-2.7	1.8	2.8	2.5
42	40	**McDonnell Douglas** St. Louis,Mo.	1790	18448.0	355.0	1.9	2.4	9.2	4.4
43	39	**Amdahl** Sunnyvale,Calif.	1702	1702.5	4.4	0.3	0.2	0.3	0.3
44	43	**National Semiconductor** Santa Clara,Calif.	1656	1655.9	-150.4	-9.1	-12.6	-22.8	-21.3
45	51	**Conner Peripherals** San Jose,Calif.	1599	1599.0	92.5	5.8	6.9	13.0	8.4
46		**Merisel** El Segundo,Calif.	1585	1585.4	10.8	0.7	2.5	9.5	9.2
47	50	**Johnson Controls** Milwaukee,Wis.	1522	4626.1	98.9	2.1	3.3	8.9	5.3
48	46	**Arrow** Great Neck,N.Y.	1508	1694.2	51.2	3.0	5.2	7.7	6.1
49	52	**Computer Associates** Garden City,N.Y.	1438	1437.8	173.0	12.0	10.0	14.6	14.2
50	53	**Varian Associates** Palo Alto,Calif.	1366	1366.0	52.7	3.9	6.5	13.2	11.2

NA = not available
NM = not meaningful

*Data processing operations only

**See "Notes to the ELECTRONIC BUSINESS 200"

Cost of goods as a percentage of sales	SG&A as a percentage of sales	Sales per employee ($ thousands)	Profits per employee ($ thousands)	Five-year growth (Compounded average annual growth rate) Sales	Profits	Current ratio	Debt to capital	Foreign sales as a percentage of total sales	Fiscal year ended	Industry segment code**
39.7%	38.2%	$188.1	$-1.6	4.4%	NM	1.22	42.1	62.3%	12/91	7,10
46.4	25.7	199.0	1.6	0.4	1.9	1.17	48.9	8.6	12/91	--
49.9	27.3	162.9	8.5	15.3	7.9	1.65	16.0	55.9	10/91	1,7
46.4	32.1	115.0	-5.1	12.9	NM	1.87	2.2	60.4	6/91	12
48.2	32.5	137.0	4.3	NA	NA	NA	NA	51.0	12/91	13
73.1	**10.8**	**124.1**	**4.1**	**2.0**	**14.9**	**1.47**	**9.4**	**0.0**	**12/91**	**8**
46.6	**21.8**	**111.2**	**4.5**	**13.9**	**18.5**	**1.46**	**28.1**	**55.9**	**12/91**	**2,15**
49.4	**9.3**	**212.1**	**15.6**	**10.4**	**12.2**	**NA**	**77.3**	**26.6**	**12/91**	**--**
62.3	**29.0**	**144.2**	**-23.1**	**3.2**	**NM**	**1.17**	**62.0**	**51.0**	**12/91**	**10**
74.8	**18.8**	**107.8**	**-6.5**	**6.3**	**NM**	**1.52**	**32.1**	**35.1**	**12/91**	**8,15**
49.3	27.6	437.1	21.5	27.1	15	2.35	7.8	44.8	9/91	5
66.3	18.6	106.4	5.7	6.7	NM	1.29	30.4	33.8	12/91	7,9
76.0	8.9	129.5	6.9	4.9	4.6	1.38	25.6	17.7	12/91	8
39.7	16.0	194.3	33.3	30.4	NM	2.94	10.8	51.3	12/91	15
75.0	11.6	137.1	6.9	-0.6	-0.3	1.45	19.4	25.7	9/91	--
53.0	**35.4**	**114.0**	**5.2**	**8.5**	**0.8**	**3.18**	**24.8**	**7.8**	**6/91**	**4**
43.8	**28.7**	**145.8**	**0.1**	**11.0**	**-46.1**	**1.2**	**62.6**	**44.0**	**12/91**	**--**
86.1	**0.7**	**135.7**	**4.3**	**-0.3**	**-6.1**	**1.23**	**39.8**	**13.0**	**12/91**	**--**
53.1	**24.9**	**150.8**	**13.0**	**8.1**	**8.2**	**1.73**	**19.0**	**48.5**	**12/91**	**--**
47.7	**25.2**	**257.7**	**15.2**	**72.6**	**86.2**	**2.53**	**25.9**	**51.4**	**6/91**	**5**
75.7	8.1	62.3	1.5	42.2	12.7	2.0	35.9	36.4	6/91	14
57.7	22.1	327.1	13.1	39.2	25.0	2.79	3.7	57.6	12/91	5
71.5	18.1	100.9	-9.6	0.2	NM	0.77	50.6	24.5	12/91	--
73.2	11.1	99.8	1.2	2.9	-13.4	1.73	19.8	25.8	7/91	8
77.1	7.3	101.4	5.2	5.0	11.1	1.71	27.1	0.0	12/91	8
61.4	**23.3**	**99.0**	**0.6**	**9.8**	**-23.2**	**1.75**	**40.1**	**30.2**	**6/91**	**7,8**
61.1	**19.1**	**89.5**	**3.8**	**26.2**	**11.3**	**1.64**	**55.0**	**20.7**	**3/91**	**8**
73.8	**10.6**	**111.0**	**-2.0**	**5.6**	**NM**	**1.14**	**49.5**	**31.6**	**12/91**	**--**
79.5	**11.5**	**120.4**	**-2.8**	**3.7**	**NM**	**1.15**	**48.3**	**39.3**	**12/91**	**-**
59.1	**0.0**	**180.0**	**14.0**	**67.0**	**5.2**	**1.05**	**61.8**	**0.0**	**12/91**	**--**
58.6	18.0	123.8	10.4	9.9	9.6	1.82	16.9	60.5	12/91	3
NA	4.8	185.6	7.4	66.0	9.8	NA	52.9	30.9	12/91	--
93.8	5.5	216.6	-6.8	2.8	NM	1.0	28.7	43.6	12/91	--
51.4	9.2	290.9	10.5	7.6	-1.8	1.45	33.1	46.4	12/91	--
81.3	4.4	188.3	10.1	12.3	18.7	1.41	14.0	60.9	12/91	--
61.2	**19.3**	**106.9**	**9.1**	**7.2**	**8.1**	**1.43**	**27.2**	**34.8**	**9/91**	**--**
28.2	**40.1**	**113.3**	**9.8**	**10.9**	**13.0**	**0.65**	**62.6**	**22.5**	**12/91**	**13**
15.5	**32.3**	**224.1**	**56.3**	**56.3**	**63.8**	**3.51**	**0.0**	**57.3**	**6/91**	**16**
82.6	**6.8**	**106.9**	**5.9**	**11.9**	**12.2**	**3.51**	**10.8**	**8.8**	**12/91**	**8**
46.6	**37.5**	**124.6**	**-22.5**	**-4.4**	**NM**	**1.13**	**90.9**	**55.8**	**6/91**	**12**
31.0	43.6	172.1	3.1	19.8	-11.4	1.71	10.2	55.6	9/91	12
82.5	6.2	169.1	3.3	8.8	1.5	NA	52.5	33.4	12/91	--
53.5	21.1	181.1	0.5	12.0	-35.4	2.44	13.9	40.9	12/91	10
65.4	14.2	57.1	-5.0	14.5	NM	1.47	6.5	51.3	5/91	15
77.1	6.5	195.0	11.3	NA	NA	6.65	35.2	63.6	12/91	14
89.9	**7.5**	**1093.4**	**7.5**	**NA**	**NA**	**2.36**	**2.6**	**4.6**	**12/91**	**6**
80.2	**10.4**	**106.8**	**2.2**	**13.1**	**2.0**	**1.25**	**40.8**	**19.6**	**9/91**	**--**
74.3	**19.3**	**240.1**	**8.5**	**4.2**	**20.9**	**5.8**	**20.2**	**0.0**	**6/91**	**6**
NA	**54.3**	**201.2**	**23.8**	**21.5**	**27.4**	**2.46**	**2.5**	**53.2**	**3/91**	**16**
64.0	**19.6**	**148.2**	**6.2**	**11.7**	**NM**	**1.7**	**15.1**	**46.2**	**9/91**	**7,9**

(Continued)

Rank 1991	Rank 1990	Company Location	Calendar year 1991 Electronics sales ($ millions)	Total sales ($ millions)	Net profits ($ millions)	Profits as a percentage of sales	Fiscal year 1991 Return on assets	Return on equity	Return on investment
51	54	**United Technologies** Hartford,Conn.	$1,340	$20,840.0	$-1,021.0	-4.9%	-6.4%	-25.8%	-13.9%
52	48	**Zenith Electronics** Glenview,Ill.	1322	1321.6	-51.6	-3.9	-7.5	-16.7	-11.3
53	49	**Tektronix** Beaverton,Ore.	1311	1310.9	44.9	3.4	5.4	11.3	8.4
54	44	**Control Data** Minneapolis,Minn.	1288	1524.9	-8.6	-0.6	-0.7	-1.9	-1.3
55	61	**Advanced Micro Devices** Sunnyvale,Calif.	1227	1226.6	145.3	11.8	11.2	18.5	14.6
56	56	**Data General** Westboro,Mass.	1212	1212.0	77.2	6.4	9.1	17.3	12.9
57	63	**Intergraph** Huntsville,Ala.	1195	1195.4	71.1	5.9	7.1	9.4	9.1
58	58	**Storage Technology** Louisville,Colo.	1175	1174.8	93.1	7.9	5.5	10.5	6.7
59	62	**Oracle Systems** Redwood Shores,Calif.	1085	1085.2	65.0	6.0	-1.4	-3.6	-2.3
60	77	**Quantum** Milpitas,Calif.	1074	1073.6	49.6	4.6	15.1	31.0	31.0
61	64	**Grumman** Bethpage,N.Y.	1055	4037.9	99.3	2.5	4.2	10.1	5.8
62	65	**Arrow Electronics** Melville,N.Y.	1044	1043.7	8.7	0.8	1.2	3.8	1.6
63	55	**Chrysler** Highland Park,Mich.	1030	29370.0	-795.0	-2.7	-1.2	-8.8	-2.1
64	57	**SCI Systems** Huntsville,Ala.	997	996.7	-1.4	-0.1	0.6	1.9	0.8
65	59	**General Dynamics** Falls Church,Va.	985	8751.0	374.0	4.3	6.0	18.9	13.1
66	73	**Maxtor** San Jose,Calif.	961	961.0	-65.8	-6.8	-10	-32.5	-15.2
67	60	**Western Digital** Irvine,Calif.	916	915.9	-95.7	-10.4	-21.6	-72.5	-30.9
68	74	**Corning** Corning,N.Y.	902	3259.2	311.2	9.5	8.1	15.4	11.1
69	67	**Eaton** Cleveland,Ohio	900	3381.0	62.0	1.8	2.0	5.4	3.0
70	87	**Dell Computer** Austin,Tex.	890	889.9	50.9	5.7	9.1	18.6	16.1
71	70	**Medtronic** Minneapolis,Minn.	875	1124.5	154.3	13.7	13.0	19.5	17.1
72	71	**Cray Research** Eagan,Minn.	862	862.5	113.0	13.1	10.5	14.9	13.0
73	68	**Northrop** Los Angeles,Calif.	861	5694.2	268.2	4.7	8.6	22.7	15.5
74	66	**Teledyne** Los Angeles,Calif.	860	3206.8	-25.4	-0.8	-1.5	-5.6	-2.7
75	69	**Beckman Instruments** Fullerton,Calif.	858	857.9	38.1	4.4	5.3	11.1	8.8
76	79	**Lotus Development** Cambridge,Mass.	829	828.9	43.1	5.2	5.9	12.9	8.7
77	82	**AST Research** Irvine,Calif.	827	827.3	70.2	8.5	13.3	22.9	20.6
78	75	**EG&G** Wellesley,Mass.	825	2688.5	81.2	3.0	11.6	19.3	15.8
79	76	**Emerson Radio** North Bergen,N.J.	790	790.2	-60.7	-7.7	-26.9	-1335.1	-29.7
80	72	**General Signal** Stamford,Conn.	750	1615.8	64.0	4.0	5.4	13.4	8.2
81	81	**Molex** Lisle,Ill.	740	739.8	63.3	8.5	9.1	12.8	12.5
82	78	**Perkin-Elmer** Norwalk,Conn.	730	873.5	0.1	0.0	-0.3	-1.0	-0.6
83	88	**Novell** Provo,Utah	710	710.4	184.2	25.9	22.4	27.1	27.0
84	80	**LSI Logic** Milpitas,Calif.	698	697.8	8.3	1.2	1.1	2.8	1.7
85	84	**Applied Materials** Santa Clara,Calif.	661	661.0	28.4	4.3	4.0	8.1	5.4
86		**Tech Data** Clearwater,Fla.	647	647.0	11.9	1.8	5.9	12.6	8.4
87	96	**Silicon Graphics** Mountain View,Calif.	638	637.9	36.6	5.7	5.1	6.6	6.3
88	89	**Eli Lilly** Indianapolis,Ind.	620	5725.7	1314.7	23.0	15.8	26.5	21.7
89	110	**Mark IV Industries** Amherst,N.Y.	581	1123.3	29.5	2.6	2.3	14.0	2.7
90	85	**Marshall Industries** El Monte,Calif.	563	563.0	16.2	2.9	6.8	10.9	8.3
91	86	**Raychem** Menlo Park,Calif.	560	1249.5	-23.4	-1.9	-1.9	-3.6	-2.6
92	91	**Analog Devices** Norwood,Mass.	536	536.0	3.5	0.7	1.6	2.3	2.1
93	98	**Teradyne** Boston,Mass.	509	508.9	18.3	3.6	4.3	6.0	5.4
94	94	**Westmark International** Seattle,Wash.	505	504.7	21.4	4.2	4.7	6.8	6.4
95	83	**Scientific Atlanta** Atlanta,Ga.	503	502.8	-3.3	-0.7	0.3	0.4	0.4
96	104	**Everex Systems** Fremont,Calif.	492	492.5	-31.3	-6.4	-20.3	-52.1	-35.8
97	106	**Dover** New York,N.Y.	492	2195.8	128.2	5.8	9.5	15.5	13.2
98		**Amphenol** Wallingford,Conn.	489	489.1	-6.5	-1.3	-0.9	-2.8	-1.1
99	95	**Dynatech** Burlington,Mass.	477	477.4	12.5	2.6	5.3	10.4	6.7
100		**Fisher Scientific** Hampton,N.H.	470	757.7	7.7	1.0	1.8	7.3	5.8

NA = not available
NM = not meaningful

**See 'Notes to the ELECTRONIC BUSINESS 200'

Cost of goods as a percentage of sales	SG&A as a percentage of sales	Sales per employee ($ thousands)	Profits per employee ($ thousands)	Five-year growth (Compounded average annual growth rate) Sales	Profits	Current ratio	Debt to capital	Foreign sales as a percentage of total sales	Fiscal year ended	Industry segment code**
75.1%	14.5%	$112.6	$-5.5	5.9%	NM	1.36	46.1	55.7%	12/91	--
88.6	7.7	47.7	-1.9	-1.4	NM	2.11	32.6	4.8	12/91	4
43.9	30.7	111.4	4.0	-0.3	4.4	1.49	25.5	49.7	5/91	9
59.7	24.9	117.3	-0.7	-14.5	NM	1.69	31.0	35.1	12/91	7,10
41.0	20.0	109.0	12.9	8.2	NM	1.38	21.2	56.6	12/91	15
45.1	**31.3**	**144.6**	**10.1**	**-0.6**	**71.9**	**2.43**	**25.7**	**52.0**	**9/91**	**12**
45.0	**29.9**	**116.1**	**6.9**	**11.4**	**0.2**	**3.42**	**3.5**	**46.4**	**12/91**	**5**
61.2	**18.6**	**156.9**	**9.2**	**17.9**	**53.6**	**1.97**	**36.1**	**39.2**	**12/91**	**14**
72.7	**9.8**	**137.7**	**-1.7**	**79.3**	**NM**	**1.22**	**36.5**	**61.6**	**5/91**	**16**
74.0	**7.4**	**607.4**	**51.1**	**48.6**	**27.2**	**1.6**	**0.0**	**44.7**	**3/91**	**14**
88.8	3.1	171.1	4.2	2.9	4.8	3.88	42.3	8.3	12/91	--
77.9	16.7	248.5	2.1	15.8	NM	2.76	59.1	0.0	12/91	6
85.5	11.4	206.3	-4.3	3.1	NM	NA	76.1	18.9	12/91	--
88.7	1.8	115.6	0.4	19.1	-24.2	2.98	56.0	43.5	6/91	--
82.6	7.6	108.6	4.6	-0.5	98.9	1.39	30.8	15.7	12/91	--
82.8	**9.7**	**104.9**	**-5.5**	**56.4**	**NM**	**1.77**	**53.2**	**26.8**	**3/91**	**14**
78.0	**11.8**	**146.3**	**-19.9**	**26.8**	**NM**	**1.9**	**57.3**	**60.3**	**6/91**	**14**
58.0	**19.1**	**106.2**	**10.1**	**10.9**	**11.3**	**1.74**	**28.0**	**27.4**	**12/91**	**--**
72.1	**14.0**	**94.8**	**1.7**	**4.3**	**-14.8**	**1.7**	**44.6**	**31.2**	**12/91**	**--**
66.7	**20.3**	**296.6**	**17.0**	**66.5**	**88.1**	**2.23**	**13.1**	**36.4**	**1/92**	**5**
27.9	38.6	135.1	17.6	19.9	14.4	2.1	12.6	42.1	4/91	11
22.7	18.4	159.9	21.0	7.6	-2.0	2.7	13.0	55.1	12/91	10
79.7	9.3	157.3	7.4	0.3	45.6	1.51	31.7	0.0	12/91	--
77.6	15.9	109.1	-0.9	-0.2	NM	1.79	52.3	16.7	12/91	--
42.2	33.0	124.3	5.5	7.7	12.4	1.86	20.7	55.6	12/91	11
12.5	**53.2**	**192.8**	**10.0**	**24.0**	**-2.2**	**1.76**	**32.9**	**50.8**	**12/91**	**16**
62.3	**18.5**	**232.6**	**21.9**	**31.9**	**18.9**	**2.99**	**10.2**	**40.1**	**6/91**	**5**
85.8	**8.3**	**75.5**	**2.3**	**17.7**	**11.1**	**1.89**	**18.1**	**7.6**	**12/91**	**--**
94.0	**5.3**	**929.7**	**-71.5**	**7.0**	**NM**	**0.86**	**97.8**	**0.0**	**12/91**	**4**
68.8	**20.6**	**109.6**	**4.3**	**2.9**	**-1.0**	**1.68**	**38.9**	**29.8**	**12/91**	**--**
49.6	26.2	101.8	9.3	19.4	15.1	2.75	2.0	75.8	6/91	3
47.7	32.8	137.6	-0.4	10.7	NM	1.24	36.9	64.3	7/91	9
15.5	33.2	225.1	57.2	39.8	62.6	4.68	0.4	43.8	10/91	16
54.5	19.6	166.0	2.0	29.1	11.4	2.4	40.0	47.5	12/91	15
54.1	17.7	180.2	7.4	33.7	69.8	2.17	33.1	66.1	10/91	--
89.2	**6.8**	**937.6**	**17.2**	**NA**	**NA**	**1.82**	**33.0**	**0.0**	**1/92**	**6**
40.4	**34.2**	**220.0**	**13.2**	**67.7**	**76.9**	**4.13**	**5.8**	**52.8**	**6/91**	**5**
23.7	**26.8**	**185.9**	**42.7**	**14.3**	**18.7**	**1.29**	**17.9**	**36.7**	**12/91**	**--**
60.4	**20.6**	**82.2**	**2.2**	**61.6**	**39.4**	**3.22**	**80.4**	**20.1**	**2/91**	**7**
76.0	**17.1**	**364.2**	**10.8**	**18.9**	**43.3**	**4.09**	**24.2**	**0.0**	**5/91**	**6**
45.1	35.8	109.5	-2.1	9.4	NM	2.55	28.9	66.7	6/91	--
40.9	28.3	103.4	1.6	10.0	-18.9	2.57	10.7	53.8	10/91	15
51.0	24.8	118.4	4.2	7.7	NM	2.51	9.4	47.0	12/91	9
49.2	30.4	136.0	5.8	15.7	NM	2.93	7.1	31.0	12/91	11
68.1	19.7	164.6	0.4	1.0	NM	3.58	0.9	22.0	6/91	2
77.1	**17.0**	**186.0**	**-21.0**	**46.4**	**NM**	**1.37**	**31.4**	**17.4**	**7/91**	**5,14**
68.1	**20.6**	**116.2**	**6.8**	**8.8**	**8.9**	**1.59**	**14.6**	**35.9**	**12/91**	**--**
60.7	**16.2**	**86.6**	**-1.2**	**1.8**	**NM**	**2.57**	**60.9**	**41.7**	**12/91**	**3**
42.8	**34.7**	**152.8**	**4.9**	**11.3**	**-6.3**	**2.88**	**35.2**	**30.4**	**3/91**	**2**
67.1	**25.7**	**236.8**	**2.4**	**5.2**	**NA**	**1.78**	**20.3**	**0.0**	**12/91**	**11**

(Continued)

Rank 1991	Rank 1990	Company	Location	Calendar year 1991 Electronics sales ($ millions)	Total sales ($ millions)	Net profits ($ millions)	Profits as a percentage of sales	Fiscal year 1991 Return on assets	Return on equity	Return on investment
101	90	**DSC Communications**	Plano,Tex.	$461	$461.5	$-108.3	-23.5%	-18.1%	-62.0%	-23.7%
102	107	**Tandon**	Moorpark,Calif.	461	461.4	-48.0	-10.4	-19.9	-98.7	-45.8
103	120	**Micron Technology**	Boise,Idaho	457	456.9	15.0	3.3	0.7	1.0	0.9
104	103	**Diebold**	Canton,Ohio	456	506.2	35.7	7.1	6.7	9.0	8.9
105	92	**Reliance Electric**	Cleveland,Ohio	455	1516.0	34.0	2.2	2.9	50.7	5.2
106	97	**Monsanto**	St. Louis,Mo.	450	8864.0	296.0	3.3	3.2	8.1	5.0
107	113	**Stratus Computer**	Marlborough,Mass.	449	448.6	49.7	11.1	12.9	15.8	15.4
108	100	**Vishay Intertechnology**	Malvern,Pa.	442	442.3	20.9	4.7	4.7	10.4	5.9
109	112	**Applied Magnetics**	Goleta,Calif.	440	440.3	-20.5	-4.7	-6.1	-12.2	-8.2
110	199	**Borland International**	Scotts Valley,Calif.	437	436.5	-75.1	-17.2	19.8	31.6	28.1
111	93	**Penn Central**	Cincinnati,Ohio	435	1669.4	63.4	3.8	1.9	4.3	2.9
112	114	**Polaroid**	Cambridge,Mass.	435	2070.6	683.7	33.0	36.2	88.5	48.2
113	111	**Anthem Electronics**	San Jose,Calif.	420	419.6	23.3	5.6	12.8	15.6	15.6
114	108	**Premier Industrial**	Cleveland,Ohio	419	631.7	73.1	11.6	21.4	25.6	25.0
115	118	**Andrew**	Orland Park,Ill.	419	418.5	22.4	5.3	6.5	10.2	7.9
116	124	**VLSI Technology**	San Jose,Calif.	413	413.4	9.9	2.4	2.7	6.1	3.4
117		**Black & Decker**	Towsen,Md	410	4637.0	53.0	1.1	1.0	5.2	1.4
118	102	**Mentor Graphics**	Wilsonville,Ore.	400	400.1	-61.6	-15.4	-13.8	-23	-19.1
119	162	**Ask Computer Systems**	Mountain View	396	395.5	-56.3	-14.2	0.7	1.5	1.2
120	176	**Cadence Design Systems**	San Jose,Calif.	392	392.3	-21.7	-5.5	-6.2	-11.5	-10.1
121	115	**M/A-Com**	Wakefield,Mass.	379	378.8	17.1	4.5	4.8	14.6	8.5
122	105	**ESCO Electronics**	St. Louis,Mo.	370	453.1	-67.3	-14.9	-12.3	-17.3	-16.5
123	101	**3Com**	Santa Clara,Calif.	370	369.6	-32.8	-8.9	-10.2	-14.5	-14.5
124	121	**Pioneer-Standard**	Cleveland,Ohio	360	360.3	6.3	1.7	5.7	15.7	8.5
125	119	**Wyle Laboratories**	El Segundo,Calif.	360	453.4	9.7	2.1	2.2	4.0	2.9
126	123	**Smith Corona**	New Canaan,Conn.	357	357.0	17.2	4.8	10.7	24.3	17.2
127	128	**Sequa**	New York,N.Y.	355	1878.8	15.0	0.8	0.7	2.2	1.0
128	117	**Micropolis**	Chatsworth,Calif.	351	350.9	4.3	1.2	1.8	3.8	2.2
129	178	**Becton Dickinson**	Franklin Lakes,N.J.	351	2190.9	182.1	8.3	6.8	13.9	8.5
130	122	**Archive**	Costa Mesa,Calif.	345	344.9	-49.3	-14.3	-18.9	-94.4	-26.7
131	160	**Thermo Electron**	Waltham,Mass.	342	805.5	47.1	5.8	3.9	9.8	6.4
132	138	**Acuson**	Mountain View,Calif.	336	336.3	58.5	17.4	23.5	29.3	29.3
133	132	**LTV**	Dallas,Tex.	330	5986.4	74.1	1.2	1.1	NM	NM
134	141	**Audiovox**	Hauppauge,N.Y.	328	328.0	-14.7	-4.5	-10.7	-31.4	-13.7
135	131	**Imo Industries**	Lawrenceville,N.J.	320	1024.0	11.4	1.1	1.1	3.4	1.4
136	175	**Symbol Technologies**	Bohemia,N.Y.	319	319.4	22.8	7.1	6.4	8.7	7.9
137	184	**Solectron**	San Jose,Calif.	317	317.3	11.2	3.5	6.8	19.6	14.0
138	125	**Cubic**	San Diego,Calif.	317	317.1	11.1	3.5	5.2	9.3	7.0
139	130	**Savin**	Stamford,Conn.	312	312.3	-97.4	-31.2	-97.4	NM	NM
140	127	**Inmac**	Santa Clara,Calif.	298	298.1	3.8	1.3	6.3	14.9	9.9
141	172	**Teradata**	El Segundo,Calif.	297	297.0	9.1	3.1	-0.9	-1.5	-1.2
142	126	**Sprague Technologies**	Stamford,Conn.	294	294.1	-52.5	-17.9	-30.9	-48.4	-38.5
143	137	**QMS**	Mobile,Ala.	294	293.6	14.5	4.9	10.6	18.5	14.9
144	136	**Sundstrand**	Rockford,Ill.	290	1669.2	108.8	6.5	6.3	15.7	9.5
145	159	**Pittway**	Northbrook,Ill.	290	981.6	25.5	2.6	3.4	6.4	4.9
146	180	**Cypress Semiconductor**	San Jose,Calif.	287	286.8	34.2	11.9	9.1	11.4	11.2
147	155	**Logicon**	Torrance,Calif.	287	286.7	12.3	4.3	8.7	12.4	12.4
148	145	**ADC Telecommunications**	Minneapolis	286	285.7	14.0	4.9	8.9	13.9	10.8
149	171	**Autodesk**	Sausalito,Calif.	285	284.9	57.8	20.3	17.6	21.6	21.6
150	149	**Diasonics**	Milpitas,Calif.	285	284.6	18.9	6.6	6.9	11.3	9.7

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Cost of goods as a percentage of sales	SG&A as a percentage of sales	Sales per employee ($ thousands)	Profits per employee ($ thousands)	Five-year growth (Compounded average annual growth rate) Sales	Profits	Current ratio	Debt to capital	Foreign sales as a percentage of total sales	Fiscal year ended	Industry segment code**
58.4%	19.2%	$141.5	$-33.2	18.8%	NM	1.02	61.7	10.4%	12/91	2
77.6	28.0	278.6	-29.0	35.8	NM	1.24	53.6	78.6	12/91	5
57.0	10.6	103.9	1.2	54.1	NM	2.17	15.9	26.0	8/91	15
62.7	19.1	131.2	9.3	3.9	0.5	2.78	0.8	21.9	12/91	1
69.3	16.5	107.4	2.4	5.4	6.3	2.54	89.8	13.8	12/91	--
49.3	**20.0**	**225.7**	**7.5**	**5.2**	**-7.3**	**1.71**	**37.7**	**36.4**	**12/91**	**--**
31.5	**30.2**	**180**	**19.9**	**29.2**	**29.8**	**4.77**	**2.4**	**47.4**	**12/91**	**12**
65.8	**17.2**	**50.8**	**2.4**	**49.8**	**16.1**	**2.65**	**43.1**	**51.9**	**12/91**	**3**
75.1	**8.9**	**45.5**	**-1.8**	**28.9**	**NM**	**1.17**	**33.0**	**56.2**	**9/91**	**3**
17.8	**52.4**	**230**	**27.2**	**50.2**	**97.2**	**2.09**	**11.0**	**37.8**	**3/91**	**16**
NA	0.0	138.0	5.2	3.8	NM	NA	31.2	0.0	12/91	--
48.2	28.4	172.5	57.0	4.9	44.6	2.08	45.5	46.2	12/91	--
76.8	12.9	694.8	38.6	32.1	49.3	4.84	0.0	8.0	12/91	6
50.3	29.5	135.6	15.9	7.9	12.5	7.19	2.2	10.5	5/91	6
56.9	23.6	123.5	6.6	16.1	18.4	3.53	22.3	40.5	9/91	2
52.0	**17.8**	**178.6**	**4.3**	**29.9**	**150.5**	**1.69**	**45.0**	**42.6**	**12/91**	**15**
60.4	**26.6**	**120.1**	**1.4**	**21.0**	**14.0**	**1.26**	**73.6**	**43.9**	**12/91**	**--**
42.6	**38.5**	**164.1**	**-25.3**	**15.3**	**NM**	**2.36**	**17.1**	**51.1**	**12/91**	**16**
28.3	**49.2**	**160.6**	**1.2**	**35.2**	**-14.8**	**1.33**	**24.7**	**37.2**	**6/91**	**16**
15.7	**47.6**	**151.6**	**-8.4**	**61.5**	**NM**	**2.0**	**11.6**	**36.1**	**12/91**	**16**
60.5	22.4	76.0	3.4	6.4	58.8	1.65	41.8	25.2	9/91	2
86.3	16.8	92.5	-13.0	-1.2	NM	2.1	4.4	25.3	9/91	8
46.6	31.2	238.9	-16.6	33.5	NM	3.05	0.5	45.3	5/91	2
76.5	17.4	358.7	8.6	13.1	NM	2.39	45.9	0.0	3/91	6
76.8	18.3	237.4	2.4	8.1	1.6	3.64	28.5	0.0	1/92	6
71.9	**14.9**	**116.2**	**5.9**	**5.0**	**5.2**	**2.71**	**29.2**	**20.8**	**6/91**	**13**
74.1	**14.0**	**119.7**	**1.0**	**37.9**	**-11.7**	**1.93**	**55.5**	**38.7**	**12/91**	**--**
75.2	**9.5**	**126.2**	**1.6**	**10.5**	**-25.0**	**3.89**	**41.3**	**66.6**	**12/91**	**14**
47.1	**26.4**	**116.8**	**10.2**	**12.5**	**13.5**	**1.94**	**39.2**	**43.1**	**9/91**	**--**
61.5	**21.6**	**138.9**	**-19.8**	**34.4**	**NM**	**1.28**	**71.7**	**28.3**	**9/91**	**14**
63.3	22.0	135.0	7.9	17.5	23.9	2.56	35.1	37.0	12/91	--
36.7	25.6	238.0	41.4	39.3	48.1	4.3	0.0	24.8	12/91	11
88.5	6.2	173.0	2.1	-3.8	NM	2.87	NM	0.0	12/91	--
82.1	17.0	517.3	-23.1	10.0	NM	4.09	56.2	0.0	11/91	4
70.0	17.1	119.1	1.3	23.4	NM	1.96	58.2	38.7	12/91	--
44.2	**30.6**	**145.2**	**i0.3**	**69.0**	**77.3**	**3.55**	**8.5**	**29.7**	**12/91**	**1**
82.2	**6.2**	**124.5**	**4.3**	**44.6**	**NM**	**1.49**	**28.4**	**0.0**	**8/91**	**--**
71.8	**18.1**	**99.3**	**4.5**	**-0.7**	**82.1**	**3.03**	**24.5**	**0.0**	**9/91**	**7,8**
65.9	**32.9**	**267.1**	**-83.3**	**-2.9**	**NM**	**0.48**	**NM**	**19.1**	**12/91**	**13**
63.8	**30.8**	**237.5**	**5.3**	**19.5**	**5.8**	**1.57**	**33.6**	**65.2**	**7/91**	**--**
33.9	35.4	172.7	-1.6	71.8	NM	2.36	15.7	13.4	6/91	10
82.1	14.7	314.5	-56.1	-2.2	NM	2.74	20.5	40.8	12/91	3
59.3	23.9	228.6	13.6	26.3	20.6	2.66	19.7	39.7	9/91	14
57.6	24.2	130.4	8.5	3.1	19.1	3.14	39.6	9.3	12/91	--
57.1	28.4	118.3	3.1	10.9	-1.6	1.95	22.5	27.9	12/91	--
30.2	**14.7**	**147.5**	**17.6**	**41.3**	**-8.0**	**3.45**	**2.4**	**25**	**12/91**	**15**
79.4	**12.6**	**82.0**	**2.7**	**5.3**	**-3.0**	**2.82**	**0.0**	**0.0**	**3/91**	**8**
44.5	**25.3**	**121.0**	**9.1**	**15.4**	**13.0**	**2.95**	**22.1**	**12.9**	**10/91**	**2**
8.9	**43.7**	**215.4**	**45.4**	**39.2**	**37.9**	**4.34**	**0.0**	**7.4**	**1/92**	**16**
55.9	**26.2**	**175.2**	**11.5**	**17.1**	**NM**	**2.25**	**14.4**	**61.6**	**12/91**	**11**

(Continued)

Rank 1991	Rank 1990	Company	Location	Calendar year 1991 Electronics sales ($ millions)	Total sales ($ millions)	Net profits ($ millions)	Profits as a percentage of sales	Fiscal year 1991 Return on assets	Return on equity	Return on investment
151	116	**MAI Systems**	Tustin,Calif.	$283	$283.1	$-59.8	-21.1%	-23.5%	NM	NM
152	133	**Augat**	Mansfield,Mass.	282	281.6	-22.1	-7.8	-7.5	-12.5	-9.2
153	142	**Olin**	Stamford,Conn.	280	2275.0	-13.0	-0.6	-0.6	-2.0	-1.0
154		**Komag**	Milpitas,Calif.	279	279.2	17.2	6.2	5.4	7.5	6.6
155	129	**Watkins-Johnson**	Palo Alto,Calif.	278	277.5	-22.4	-8.1	-10.5	-19.0	-14.9
156	152	**Bell**	Muncie,Ind.	275	2267.4	66.2	2.9	4.2	12.0	6.3
157	187	**Sensormatic**	Deerfield Beach,Fla.	274	274.4	27.8	10.1	5.9	11.1	9.7
158	166	**Ametek**	Paoli,Pa.	270	715.1	38.0	5.3	6.2	18.0	8.8
159	140	**Executone**	Darien,Conn.	267	266.6	1.0	0.4	0.6	1.7	0.8
160	139	**Thomas & Betts**	Bridgewater,N.J.	266	566.4	48.5	8.6	8.1	13.3	9.5
161	153	**Millipore**	Bedford,Mass.	265	748.0	60.4	8.1	7.7	12.6	9.0
162	150	**Bolt Beranek and Newman**	Cambridge	263	262.9	4.9	1.9	5.0	20.4	19.2
163		**Cabletron Systems**	Rochester,N.H.	263	262.6	52.4	19.9	23.4	25.6	25.6
164	144	**Tyco Laboratories**	Exeter,N.H.	260	3076.6	98.3	3.2	4.9	13.0	6.9
165	109	**Atari**	Sunnyvale,Calif.	258	258.0	23.7	9.2	9.3	18.8	12.7
166	148	**Datapoint**	San Antonio,Tex.	258	257.9	6.6	2.6	2.3	7.5	3.6
167	143	**Gerber Scientific**	South Windsor,Conn.	257	257.0	7.3	2.9	2.8	3.8	3.4
168	164	**International Rectifier**	El Segundo,Calif.	255	254.9	14.6	5.7	6.9	9.6	8.3
169	151	**Measurex**	Cupertino,Calif.	254	254.0	0.4	0.2	0.1	0.2	0.2
170	167	**Bell Industries**	Los Angeles,Calif.	253	401.2	-1.0	-0.3	0.4	0.7	0.5
171	154	**Reynolds and Reynolds**	Dayton,Ohio	250	591.7	25.6	4.3	4.4	9.1	7.6
172	135	**Textron**	Providence,R.I.	250	7840.0	300.0	3.8	1.9	10.2	2.9
173		**SynOptics Communications**	Santa Clara	248	248.3	26.8	10.8	16.3	19.8	19.4
174	174	**Fluke**	Everett,Wash.	246	245.6	4.1	1.7	1.9	2.8	2.7
175	134	**Concurrent Computer**	Oceanport,N.J.	238	238.0	-46.7	-19.6	-31.3	NM	NM
176		**Exabyte**	Boulder,Co	234	234.1	32.2	13.8	21.5	28.7	28.7
177		**EMC**	Hopkinton,Mass	232	232.4	13.0	5.6	6.9	10.4	8.8
178	182	**Hubbell**	Orange,Conn.	231	756.1	90.6	12.0	13.2	17.5	17.2
179		**Zeos International**	St. Paul,Minn	231	230.9	10.3	4.5	10.3	16.0	16.0
180		**Adobe Systems**	Mountain View,Calif.	230	229.7	51.6	22.5	23.3	28.2	28.2
181	158	**CTS**	Elkhart,Ind.	230	229.5	4.2	1.8	2.4	3.4	2.9
182		**Advanced Logic Research**	Irvine,Calif.	227	227.5	12.1	5.3	10.8	17.1	14.3
183	170	**Esterline**	Bellevue,Wash.	225	337.6	6.7	2.0	2.9	9.5	3.9
184	193	**Pyramid Technology**	Mountain View,Calif.	222	221.6	-11.1	-5.0	5.4	6.9	6.7
185	168	**Sun Electric**	Crystal Lake,Ill.	220	220.4	-10.6	-4.8	-6.5	-12.0	-9.9
186	181	**Qume**	Milpitas,Calif.	220	219.7	13.8	6.3	-18.9	-58.0	-31.5
187	191	**Silicon Valley Group**	San Jose,Calif.	218	217.6	0.3	0.2	0.9	1.6	1.4
188	157	**Figgie International**	Willoughby,Ohio	217	1208.2	30.1	2.5	2.9	7.9	3.7
189	156	**Genicom**	Waynesboro,Va.	217	217.0	-16.7	-7.7	-12.2	-60.2	-18.2
190		**Harnischfeger Industries**	Brookfield,Wisc.	217	1535.7	61.5	4.0	4.3	10.9	8.5
191		**Legent**	Vienna,Virg	216	216.1	10.6	4.9	12.4	15.2	14.8
192		**Read-Rite**	Milpitas,Calif.	216	215.9	27.5	12.7	15.0	51.2	39.6
193	161	**AM International**	Chicago,Ill.	215	752.5	-6.7	-0.9	1.5	4.8	2.9
194	198	**Coherent**	Palo Alto,Calif.	214	214.2	0.9	0.4	0.1	0.2	0.2
195	163	**Sequent Computer Systems**	Beaverton,Ore.	213	213.3	-48.7	-22.8	-19.8	-32.6	-24.1
196	188	**Tellabs**	Lisle,Ill.	213	212.8	6.6	3.1	3.6	4.6	4.4
197		**Syntex**	Palo Alto,Calif	210	1957.5	451.0	23.0	18.6	42.2	26.7
198		**Teltron**	Akron,Ohio	206	206.1	14.9	7.2	7.4	12.1	9.5
199		**Fischer & Porter**	Warminister,Penn.	204	237.0	-22.5	-9.5	-14.6	-49.7	-29.6
200	195	**Integrated Device Technology**	Santa Clara	204	203.6	-21.3	-10.5	0.5	0.9	0.6

NA = not available
NM = not meaningful

Compounded average annual growth rate, 1986-1991

**See "Notes to the ELECTRONIC BUSINESS 200"

Cost of goods as a percentage of sales	SG&A as a percentage of sales	Sales per employee ($ thousands)	Profits per employee ($ thousands)	Five-year growth (Compounded average annual growth rate) Sales	Profits	Current ratio	Debt to capital	Foreign sales as a percentage of total sales	Fiscal year ended	Industry segment code**
56.2%	37.0%	$127.3	$-28.7	3.7%	NM	0.41	105.0	66.2%	9/91	16
72.2	22.1	68.7	-5.4	1.6	NM	2.54	26.4	28.0	12/91	3
75.5	11.5	158.0	-0.9	5.6	NM	1.12	51.2	15.3	12/91	--
64.9	7.4	105.9	5.7	70.2	NM	2.89	11.8	57.6	12/91	14
63.5	21.7	105.9	-8.5	1.7	NM	2.44	21.3	30.4	12/91	8
80.9	**7.1**	**170.7**	**5.0**	**15.7**	**2.2**	**1.44**	**47.2**	**11.4**	**12/91**	**--**
34.9	**38.8**	**90.4**	**9.3**	**23.9**	**NM**	**NA**	**13.2**	**39.4**	**5/91**	**1**
71.3	**10.4**	**117.2**	**6.2**	**12.8**	**0.9**	**2.32**	**51.1**	**29.6**	**12/91**	**--**
58.8	**30.8**	**121.2**	**0.5**	**NA**	**NA**	**1.28**	**51.5**	**0.0**	**12/91**	**2**
54.2	**23.1**	**75.5**	**6.5**	**8.0**	**3.8**	**2.2**	**28.6**	**46.7**	**12/91**	**--**
41.0	35.9	130.0	10.5	11.0	9.1	2.31	28.5	58.4	12/91	--
52.2	26.9	118.5	4.0	8.7	-4.3	2.65	5.7	16.6	6/91	8
39.7	19.9	131.7	26.2	115.3	182.4	9.51	0.0	26.0	2/91	2
74.5	14.1	125.8	4.8	32.9	26.3	1.28	46.8	29.7	5/91	--
72.5	27.8	508.9	46.7	0.0	-1.2	3.01	32.7	86.1	12/91	4
52.2	**33.2**	**152.5**	**3.1**	**-4.0**	**NM**	**1.39**	**51.5**	**94.4**	**7/91**	**2**
51.8	**33.6**	**157.9**	**4.7**	**6.9**	**-15.2**	**3.58**	**9.7**	**42.8**	**4/91**	**1**
61.9	**19.9**	**93.6**	**6.4**	**11.7**	**NM**	**2.51**	**13.4**	**61.1**	**6/91**	**15**
59.3	**24.3**	**100.4**	**0.2**	**5.7**	**-55.0**	**2.92**	**2.1**	**68.4**	**11/91**	**1**
74.3	**21.8**	**234.6**	**0.4**	**5.8**	**-25.9**	**4.13**	**36.9**	**0.0**	**6/91**	**6**
55.6	32.1	128.6	4.8	7.6	-1.2	2.28	16.5	11.1	9/91	--
75.9	25.7	100.2	5.8	2.1	5.5	NA	71.9	44.8	12/91	--
31.0	34.9	258.9	28.0	167.9	NM	4.72	1.7	30.0	12/91	2
48.3	30.1	108.2	1.4	2.8	-23.5	2.69	0.8	35.0	9/91	9
50.0	28.5	127.5	-33.4	38.0	NM	0.47	159.4	41.8	6/91	12
57.2	**10.6**	**295.9**	**39.4**	**NA**	**NM**	**3.57**	**0.2**	**14.5**	**12/91**	**14**
50.7	**27.8**	**201.2**	**11.3**	**28.4**	**-6.8**	**2.55**	**14.8**	**26.0**	**12/91**	**14**
64.3	**17.1**	**136.7**	**16.4**	**6.2**	**10.7**	**3.1**	**1.5**	**9.1**	**12/91**	**--**
75.8	**16.0**	**310.4**	**13.8**	**186.3**	**152.6**	**2.69**	**0.0**	**0.0**	**12/91**	**5**
12.4	**32.6**	**327.6**	**73.6**	**70.2**	**70.3**	**4.38**	**0.0**	**0.0**	**11/91**	**16**
76.7	15.7	47.4	0.9	-1.3	NM	2.31	14.5	25.7	12/91	3
70.0	14.4	326.1	21.1	109.1	136.3	3.35	16.7	32.2	9/91	5
55.6	31.9	100.3	2.1	8.3	52.1	1.23	58.6	32.0	10/91	9
44.8	28.9	191.1	10.1	39.2	NM	3.11	2.3	26.0	9/91	10
57.1	40.5	100.0	-4.8	5.6	NM	1.97	17.7	59.5	12/91	9
86.3	**15.2**	**228.5**	**-20.6**	**33.1**	**NM**	**1.73**	**45.6**	**41.4**	**2/91**	**14**
60.2	**21.6**	**146.3**	**1.0**	**53.2**	**-8.8**	**2.22**	**9.0**	**37.7**	**9/91**	**--**
73.9	**16.0**	**88.2**	**2.2**	**4.9**	**-5.9**	**2.39**	**53.1**	**0.0**	**12/91**	**--**
67.6	**19.5**	**86.4**	**-6.7**	**6.6**	**NM**	**2.07**	**69.7**	**36.1**	**12/91**	**14**
77.4	**12.2**	**136.6**	**5.6**	**17.3**	**7.4**	**1.66**	**21.9**	**53.1**	**10/91**	**--**
NA	58.4	178.6	29.7	30.6	27.1	5.26	2.6	37.8	9/91	16
66.8	6.8	70.8	9.2	103.3	NA	1.99	22.7	27.9	9/91	3
67.7	24.1	144.0	1.5	9.8	NM	1.3	40.9	49.4	7/91	--
54.5	29.5	130.4	0.1	8.5	NM	2.34	15.3	5.01	9/91	9
41.1	46.7	156.4	-35.7	60.5	NM	1.76	26.0	45.8	12/91	10
48.5	**27.1**	**101.6**	**3.2**	**12.9**	**-4.6**	**4.04**	**3.1**	**36.9**	**12/91**	**2**
14.3	**37.0**	**166.7**	**38.9**	**13.1**	**15.3**	**1.48**	**36.7**	**31.4**	**7/91**	**--**
45.8	**31.5**	**153.8**	**10.3**	**17.6**	**9.4**	**3.86**	**21.4**	**33.6**	**3/91**	**1**
62.0	**28.1**	**98.2**	**-9.3**	**6.0**	**NM**	**1.69**	**40.4**	**62.8**	**12/91**	**9**
35.7	**22.0**	**96.8**	**0.6**	**28.3**	**-17.5**	**2.19**	**35.4**	**13.7**	**3/91**	**15**

Every industry segment tells a story

The biggest story for the electronics industry this year is plummeting profits. Profitability, as measured by the ratio of net profits to sales, actually fell in calendar year 1991 for two segments of the industry: Minicomputers was a negative 6%, and mainframes, a minus 2.4%. The minicomputer segment was the only one to suffer two consecutive years of red ink, thanks to large losses at Wang, Concurrent Computer, DEC, and Tandem Computer. Three segments improved profitability: instruments (up 0.6 percentage points); computer-based systems (up 0.2 points); and the perennial favorite, software (up only 0.1 points, but still number one at 10%).

Despite all the attention to cost cutting, only four segments reduced manufacturing costs as a share of sales from fiscal 1990 to 1991. The star performers were communications (down 7.2 points) and semiconductors (down 4.4 points). Component and minicomputer makers also reined in their group costs slightly. The laggards were software and distribution, where weighted average costs as a share of sales rose 5.4 points each. Year-to-year comparisons in the distribution segment, however, may be misleading. This year, the definition of distribution was broadened to include distributors of computers as well as components, so two new companies—Merisel and Tech Data—were added to the list. (For more about confusion with industry segment comparisons, see "Notes to the ELECTRONIC BUSINESS 200.")

Productivity, as measured by sales per employee, rose nearly across the board. Only the consumer electronics segment failed to perform—its productivity fell 4.3% from 1990 to 1991. Distributors and desktop computer makers cranked out more money per employee than any other segment. Five—distribution, medical electronics, peripherals, semiconductors, and computer-based systems—increased productivity by more than 10%.

The march to foreign markets was fairly erratic. Six segments—semiconductors, minicomputers, components, instruments, and peripherals—increased foreign sales (as a share of total sales) by 3 points or more from 1990 to 1991. Three—consumer, government, and medical electronics—took significant steps backwards. □

A quick comparison of the industry segments

Segment (# of companies)	Profitability (profits/sales) 1990	1991	Cost of goods sold (as % of sales) 1990	1991	Productivity (sales/employee) 1990	1991	Foreign sales (as % of sales) 1990	1991
Computer-based systems (7)	5.6%	5.8%	49.5%	50.1%	$141,100	$157,700	52.9%	54.4%
Communications (13)	4.0	3.3	55.3	48.1	110,300	116,700	48.2	49.1
Components (9)	6.5	4.4	62.5	62.1	86,900	89,800	51.7	55.2
Consumer electronics (5)	2.5	1.0	65.2	66.0	108,900	104,200	10.0	8.9
Desktop computers (11)	8.3	4.5	50.0	53.4	263,600	286,000	47.1	47.6
Distribution (10)	3.9	2.7	72.3	77.7	255,900	313,300	0.0	2.2
Diversified (8)	7.5	0.9	42.3	44.8	157,500	165,700	56.2	57.0
Government (13)	3.7	2.5	71.7	73.5	107,500	111,000	21.3	15.0
Instruments (10)	3.1	3.7	58.5	60.2	108,500	113,100	37.8	41.1
Mainframes (8)	6.9	-2.4	40.9	42.7	169,000	179,300	58.5	59.6
Medical electronics (6)	8.6	7.7	40.2	44.8	133,000	154,200	42.4	35.2
Minicomputers (6)	-3.8	-6.0	44.7	44.5	112,900	122,600	54.8	58.4
Office equipment (4)	4.7	3.6	42.6	45.3	131,000	132,400	44.6	44.5
Peripherals (15)	3.3	1.2	70.2	72.5	104,400	118,200	39.6	42.7
Semiconductors (12)	3.3	3.2	57.6	53.2	100,700	113,200	44.7	48.5
Software (13)	9.9	10.0	15.8	21.2	173,700	186,300	48.6	49.3

All data are weighted averages based on fiscal years, except profitability, which is based on calendar years. For a list of companies in each segment, see accompanying detailed industry segment tables.

Source: ELECTRONIC BUSINESS

ELECTRONIC BUSINESS 200 INDUSTRY SEGMENTS

Fiscal year 1991

Company	200 rank	Sales per employee ($ thousands)	rank	Cost of goods sold as a percentage of sales	rank	Capital expenditures as a percentage of sales	rank	Foreign sales as a percentage of sales	rank
1 -Industry segment code **COMPUTER-BASED SYSTEMS**									
Diebold	104	$131.2	5	62.7%	7	1.8%	7	21.9%	7
Gerber Scientific	167	157.9	2	51.8	5	2.4	6	42.8	3
Hewlett-Packard	3	162.9	1	49.9	4	5.9	1	55.9	2
Measurex	169	100.4	6	59.3	6	3.2	5	68.4	1
Sensormatic Electronics	157	90.4	7	34.9	1	5.9	1	39.4	4
Symbol Technologies	136	145.2	4	44.2	2	5.4	3	29.7	6
Telxon	198	153.8	3	45.8	3	4.1	4	33.6	5
Weighted average		157.7		50.1		5.7		54.4	
2 -Industry segment code **COMMUNICATIONS**									
3Com	123	238.9	2	46.6	5	6.7	5	45.3	3
ADC Telecommunications	148	121.0	10	44.5	4	8.4	2	12.9	11
Andrew	115	123.5	8	56.9	9	6.0	6	40.5	4
Cabletron Systems	163	131.7	7	39.7	2	8.0	4	26.0	8
Datapoint	166	152.5	5	52.2	8	3.8	10	94.4	1
DSC Communications	101	141.5	6	58.4	10	4.8	7	10.4	12
Dynatech	99	152.8	4	42.8	3	3.5	11	30.4	6
Executone	159	121.2	9	58.8	11	0.6	13	0.0	13
Motorola	7	111.2	11	46.6	6	11.6	1	55.9	2
M/A-Com	121	76.0	13	60.5	12	4.5	8	25.2	9
Scientific Atlanta	95	164.6	3	68.1	13	4.0	9	22.0	10
SynOptics Communications	173	258.9	1	31.0	1	8.4	2	30.0	7
Tellabs	196	101.6	12	48.3	7	3.3	12	36.9	5
Weighted average		116.7		48.1		9.9		49.1	
3 -Industry segment code **COMPONENTS**									
AMP	31	123.8	2	58.6	2	10.1	3	60.5	2
Amphenol	98	86.6	4	60.7	3	2.0	9	41.7	5
Applied Magnetics	109	45.5	9	75.1	7	7.8	4	56.2	3
Augat	152	68.7	6	72.2	6	5.1	8	28.0	7
CTS	181	47.4	8	76.7	8	7.0	6	25.7	9
Molex	81	101.8	3	49.6	1	15.4	2	75.8	1
Read-Rite	192	70.8	5	66.8	5	20.1	1	27.9	8
Sprague Technologies	142	314.5	1	82.1	9	7.7	5	40.8	6
Vishay Intertechnology	108	50.8	7	65.8	4	6.0	7	51.9	4
Weighted average		89.8		62.1		9.5		55.2	
4 -Industry segment code **CONSUMER**									
Atari	165	508.9	3	72.5	2	0.8	4	86.1	1
Audiovox	134	517.3	2	82.1	3	1.2	3	0.0	–
Emerson Radio	79	929.7	1	94.0	5	0.6	5	0.0	–
Tandy	16	114.0	4	53.0	1	3.1	1	7.8	2
Zenith Electronics	52	47.7	5	88.6	4	2.8	2	4.8	3
Weighted average		104.2		66.0		2.6		8.9	

200 INDUSTRY SEGMENTS

Fiscal year 1991

Company	200 rank	Sales per employee ($ thousands)	rank	Cost of goods sold as a percentage of sales	rank	Capital expenditures as a percentage of sales	rank	Foreign sales as a percentage of sales	rank
Industry segment code									
5 DESKTOP COMPUTERS									
Advanced Logic Research	182	$326.1	3	70.0%	8	1.6%	9	32.2%	9
Apple Computer	11	437.1	1	49.3	4	3.5	6	44.8	6
AST Research	77	232.6	8	62.3	6	1.3	10	40.1	7
Compaq Computer	22	327.1	2	57.7	5	5.8	4	57.6	2
Dell Computer	70	296.6	5	66.7	7	3.7	5	36.4	8
Everex Systems	96	186.0	10	77.1	10	2.4	7	17.4	10
Intergraph	57	116.1	11	45.0	2	7.7	2	46.4	5
Silicon Graphics	87	220.0	9	40.4	1	8.6	1	52.8	3
Sun Microsystems	20	257.7	7	47.7	3	6.0	3	51.4	4
Tandon	102	278.6	6	77.6	11	2.0	8	78.6	1
Zeos International	179	310.4	4	75.8	9	1.2	11	0.0	–
Weighted average		286.0		53.4		4.6		47.6	
Industry segment code									
6 DISTRIBUTION									
Anthem Electronics	113	694.8	3	76.8	6	1.4	1	8.0	2
Arrow Electronics	62	248.5	6	77.9	8	0.4	9	0.0	–
Avnet	48	240.1	7	74.3	2	1.2	3	0.0	–
Bell Industries	170	234.6	9	74.3	2	1.4	1	0.0	–
Marshall Industries	90	364.2	4	76.0	4	1.2	3	0.0	–
Merisel	46	1093.4	1	89.9	10	0.3	10	4.6	3
Pioneer-Standard Electronics	124	358.7	5	76.5	5	1.2	3	0.0	–
Premier Industrial	114	135.6	10	50.3	1	0.9	7	10.5	1
Tech Data	86	937.6	2	89.2	9	0.6	8	0.0	–
Wyle Laboratories	125	237.4	8	76.8	6	1.1	6	0.0	–
Weighted average		313.3		77.7		0.8		2.2	
Industry segment code									
7 DIVERSIFIED									
Control Data	54	117.3	4	59.7	3	2.2	6	35.1	4
Cubic	138	99.3	6	71.8	8	1.1	8	0.0	–
Harris	26	99.0	7	61.4	5	4.4	3	30.2	6
Hewlett-Packard	3	162.9	2	49.9	2	5.9	2	55.9	2
Honeywell	12	106.4	5	66.3	7	3.9	5	33.8	5
IBM	1	188.1	1	39.7	1	10.0	1	62.3	1
Mark IV Industries	89	82.2	8	60.4	4	2.1	7	20.1	7
Varian Associates	50	148.2	3	64.0	6	4.3	4	44.3	3
Weighted average		165.7		44.8		8.5		57.0	
Industry segment code									
8 GOVERNMENT									
Bolt Beranek and Newman	162	118.5	3	52.2	1	4.0	6	16.6	8
Cubic	138	99.3	9	71.8	5	1.1	13	0.0	–
ESCO Electronics	122	92.5	11	86.3	13	2.1	11	25.3	5
E-Systems	39	106.9	5	82.6	12	2.6	10	8.8	9
GM Hughes Electronics	6	124.1	2	73.1	6	5.9	2	0.0	–
Harris	26	99.0	10	61.4	3	4.4	4	30.2	3
Litton Industries	24	99.8	8	73.2	7	4.9	3	25.8	4
Logicon	147	82.0	13	79.4	11	1.3	12	0.0	–
Loral	27	89.5	12	61.1	2	4.4	4	20.7	6
Martin Marietta	25	101.4	7	77.1	10	3.5	9	0.0	–
Raytheon	13	129.5	1	76.0	9	3.8	7	17.7	7
Texas Instruments	10	107.8	4	74.8	8	7.4	1	35.1	1
Watkins-Johnson	155	105.9	6	63.5	4	3.6	8	30.4	2
Weighted average		111.0		73.5		4.9		15.0	

Company	200 rank	Sales per employee ($ thousands)	rank	Cost of goods sold as a percentage of sales	rank	Capital expenditures as a percentage of sales	rank	Foreign sales as a percentage of sales	rank
9 INSTRUMENTS & MEASUREMENT (Industry segment code)									
Coherent	194	$130.4	3	54.5%	5	3.4%	5	51.0%	4
Esterline	183	100.3	8	55.6	6	2.0	10	32.0	10
Fischer & Porter	199	98.2	10	62.0	8	2.7	8	62.8	2
Fluke	174	108.2	6	48.3	3	4.2	3	35.0	8
Honeywell	12	106.4	7	66.3	10	3.9	4	33.8	9
Perkin-Elmer	82	137.6	2	47.7	2	3.3	6	64.3	1
Sun Electric	185	100.0	9	57.1	7	2.2	9	59.5	3
Tektronix	53	111.4	5	43.9	1	5.1	1	49.7	5
Teradyne	93	118.4	4	51.0	4	2.9	7	47.0	6
Varian Associates	50	148.2	1	64.0	9	4.3	2	42.6	7
Weighted average		113.1		60.2		3.9		41.1	
10 MAINFRAMES (Industry segment code)									
Amdahl	43	181.1	3	53.5	6	19.3	1	40.9	5
Control Data	54	117.3	8	59.7	7	2.2	8	35.1	6
Cray Research	72	159.9	5	22.7	1	5.4	6	55.1	2
IBM	1	188.1	2	39.7	3	10.0	4	62.3	1
Pyramid Technology	184	191.1	1	44.8	5	11.5	3	26.0	7
Sequent Computer Systems	195	156.4	6	41.1	4	12.3	2	45.8	4
Teradata	141	172.7	4	33.9	2	9.5	5	13.4	8
Unisys	9	144.2	7	62.3	8	2.9	7	51.0	3
Weighted average		179.3		42.7		9.2		59.6	
11 MEDICAL (Industry segment code)									
Acuson	132	238.0	1	36.7	2	4.1	4	24.8	5
Beckman Instruments	75	124.3	6	42.2	3	7.9	1	55.6	2
Diasonics	150	175.2	3	55.9	5	3.4	5	61.6	1
Fisher Scientific	100	236.8	2	67.1	6	0.4	6	0.0	6
Medtronic	71	135.1	5	27.9	1	6.4	2	42.1	3
Westmark International	94	136.0	4	49.2	4	4.7	3	31.0	4
Weighted average		154.2		44.8		4.9		35.2	
12 MINICOMPUTERS (Industry segment code)									
Concurrent Computer	175	127.5	4	50.0	6	3.0	6	41.8	6
Data General	56	144.6	3	45.1	3	6.7	3	52.0	4
Digital Equipment	4	115.0	6	46.4	4	5.3	5	60.4	1
Stratus Computer	107	180.0	1	31.5	2	7.0	2	47.4	5
Tandem Computers	41	172.1	2	31.0	1	7.2	1	55.6	3
Wang Laboratories	40	124.6	5	46.6	5	6.2	4	55.8	2
Weighted average		122.6		44.5		5.7		58.4	
13 OFFICE EQUIPMENT (Industry segment code)									
Pitney Bowes	37	113.3	4	28.2	1	7.5	1	22.5	2
Savin	139	267.1	1	65.9	3	7.2	2	19.1	4
Smith Corona	126	116.2	3	71.9	4	1.9	3	20.8	3
Xerox (data processing only)	5	137.0	2	48.2	2	1.9	3	51.0	1
Weighted average		132.4		45.3		1.6		17.7	

Industry segment code

14 PERIPHERALS

Company	200 rank	Sales per employee ($ thousands)	rank	Cost of goods sold as a percentage of sales	rank	Capital expenditures as a percentage of sales	rank	Foreign sales as a percentage of sales	rank
Archive	130	$138.9	10	61.5%	5	1.9%	15	28.3%	11
Conner Peripherals	45	195.0	6	77.1	11	5.5	5	63.6	2
EMC	177	201.2	5	50.7	1	8.5	2	26.0	13
Everex Systems	96	186.0	7	77.1	11	2.4	13	17.4	14
Exabyte	176	295.9	2	57.2	2	2.9	11	14.5	15
Genicom	189	86.4	14	67.6	7	3.2	10	36.1	10
Komag	154	105.9	12	64.9	6	19.5	1	57.6	4
Maxtor	66	104.9	13	82.8	14	5.3	6	26.8	12
Micropolis	128	126.2	11	75.2	9	4.7	8	66.6	1
QMS	143	228.6	3	59.3	3	2.7	12	39.7	7
Quantum	60	607.4	1	74.0	8	5.2	7	44.7	5
Qume	186	228.5	4	86.3	15	2.3	14	41.4	6
Seagate Technology	21	62.3	15	75.7	10	3.4	9	36.4	9
Storage Technology	58	156.9	8	61.2	4	7.0	4	39.2	8
Western Digital	67	146.3	9	78.0	13	7.8	3	60.3	3
Weighted average		118.2		72.5		5.3		42.7	

Industry segment code

15 SEMICONDUCTORS

Advanced Micro Devices	55	109.0	6	41.0	5	9.1	8	56.6	2
Analog Devices	92	103.4	9	40.9	4	9.7	7	53.8	4
Cypress Semiconductor	146	147.5	4	30.2	1	22.6	1	25.0	11
Integrated Device Technology	200	96.8	10	35.7	2	17.9	3	13.7	12
Intel	14	194.3	1	39.7	3	19.8	2	51.3	5
International Rectifier	168	93.6	11	61.9	10	5.6	12	61.1	1
LSI Logic	84	166.0	3	54.5	8	10.6	6	47.5	7
Micron Technology	103	103.9	8	57.0	9	12.2	4	26.0	10
Motorola	7	111.2	5	46.6	6	11.6	5	55.9	3
National Semiconductor	44	57.1	12	65.4	11	6.5	11	51.3	5
Texas Instruments	10	107.8	7	74.8	12	7.4	10	35.1	9
VLSI Technology	116	178.6	2	52.0	7	7.9	9	42.6	8
Weighted average		113.2		53.2		11.6		48.5	

Industry segment code

16 SOFTWARE

Adobe Systems	180	327.6	1	12.4	2	5.3	8	0.0	13
Ask Computer Systems	119	160.6	10	28.3	8	1.8	12	37.2	10
Autodesk	149	215.4	5	8.9	1	3.6	10	7.4	12
Borland International	110	230.0	2	17.8	7	12.4	3	37.8	8
Cadence Design Systems	120	151.6	11	15.7	6	7.6	5	36.1	11
Computer Associates	49	201.2	6	NA	–	1.4	13	53.2	4
Legent	191	178.6	8	NA	–	6.7	6	37.8	8
Lotus Development	76	192.8	7	12.5	3	4.7	9	50.8	6
MAI Systems	151	127.3	13	56.2	10	2.0	11	66.2	1
Mentor Graphics	118	164.1	9	42.6	9	7.8	4	51.1	5
Microsoft	38	224.1	4	15.6	5	14.3	1	57.3	3
Novell	83	225.1	3	15.5	4	13.6	2	43.8	7
Oracle Systems	59	137.7	12	72.7	11	5.9	7	61.6	2
Weighted average		186.3		21.2		7.5		49.3	

NA=Not available
Includes only companies with electronics sales over 50% of total
See "Notes to the ELECTRONIC BUSINESS 200" on page XX

Source: ELECTRONIC BUSINESS

Notes to the ELECTRONIC BUSINESS 200

Sales
Sales include revenue from products, services, and rentals, but exclude dividends, interest, and other non-operating revenue at calendar year end.

Profits
Profits are income from continuing operations after taxes and before extraordinary items or charges as shown on the income statement at calendar year end.

Debt to total capital
Debt to total capital is the ratio of long-term plus short-term debt to shareholders' equity plus long-term and short-term debt at fiscal year end.

Return on equity
ROE is profits as a percentage of shareholders' equity (preferred stock, capital stock, surpluses, and retained earnings) at fiscal year end.

Current ratio
Current ratio is the ratio of current assets to current liabilities at fiscal year end and is one measure of a company's ability to pay its debts. Lenders prefer to see a current ratio of 2:1 or more.

Return on investment
ROI is profits as a percentage of shareholders' equity plus both short-term (current portion of long-term debt, notes payable, and other borrowings) and long-term debt at fiscal year end.

Cost of goods sold
COGS includes manufacturing costs of products, services, and rentals sold, minus depreciation. COGS is expressed as a percentage of total sales at fiscal year end.

Foreign sales
Foreign sales include export revenue from U.S. operations plus sales from operations outside the U.S. to unaffiliated customers at fiscal year end.

Employees
The number of employees is supplied by each company and may represent head count at fiscal year end or average head count for the entire 12-month period.

SG&A
Selling, general, and administrative costs include all marketing and other administrative costs. SG&A costs are expressed as a percentage of total sales at fiscal year end.

Return on assets
ROA is profits as a percentage of total assets at fiscal year end.

Industry segment classification

Companies are classified in the industry segments that represent the greatest volume of their sales. For purposes of comparison, only companies with electronics sales comprising 50% or more of their total sales are included in the industry segment tables. (Prior to 1991, electronics sales of 70% or more of total sales were required.)

Comparisons between companies in like industry segments may be misleading for several reasons. One, often a company classified in one segment has a large proportion of sales from other segments, which makes comparisons with pure-play companies confusing. Two, as companies sell off or acquire divisions, the data changes drastically from year to year. Three, comparisons between companies that contract out major business functions and those that don't will often be misleading as well.

Industry segment codes

1 Computer-based systems
2 Communications equipment
3 Components (excluding semiconductors)
4 Consumer electronics
5 Desktop computers
6 Distribution
7 Diversified electronics
8 Government & military electronics
9 Instruments & measurement
10 Mainframes
11 Medical electronics
12 Minicomputers
13 Office equipment
14 Peripherals
15 Semiconductors
16 Software

Newcomers to the 200

Company	1991 Rank
Adobe Systems	180
Advanced Logic Research	182
Amphenol	98
Black & Decker	117
Cabletron Systems	163
EMC	177
Exabyte	176
Fischer & Porter	199
Fisher Scientific International	100
Harnischfeger Industries	190
Komag	154
Legent	191
Merisel	46
Read-Rite	192
SynOptics Communications	173
Syntex	197
Tech Data	86
Telxon	198
Zeos International	179

Displaced from the 200

Company	1990 Rank
Allen Group	179
Anacomp	183
Ashton-Tate	177
Bally Manufacturing	146
BancTec	200
Chips and Technologies	147
Cincinnati Milacron	173
Convex Computer	190
Cooper Industries	169
Encore Computer	185
General DataComm Industries	194
Kollmorgen	186
Morton International	196
NCR	12
Northgate Computer	192
Recognition Equipment	189
Square D	165
Ultimate	197
United Telecommunications	99

A note about R&D and capital spending

More detailed R&D data are available in this issue's top 100 R&D spenders ranking. Capital spending data will also be available in next month's top 100 capital spenders ranking.

ELECTRONIC BUSINESS 200
ALPHABETIC INDEX

Company	Rank
3Com Corp	123
3M Co	19
Acuson	132
ADC Telecommunications Inc	148
Adobe Systems Inc	180
Advanced Logic Research Inc	182
Advanced Micro Devices Inc	55
Allied-Signal Inc	29
AM International Inc	193
Amdahl Corp	43
Ametek Inc	158
AMP Inc	31
Amphenol Corp	98
Analog Devices Inc	92
Andrew Corp	115
Anthem Electronics Inc	113
Apple Computer Inc	11
Applied Magnetics Corp	109
Applied Materials Inc	85
Archive Corp	130
Arrow Electronics Inc	62
Ask Computer Systems Inc	119
AST Research Inc	77
AT&T	2
Atari Corp	165
Audiovox Corp	134
Augat Inc	152
Autodesk	149
Avnet Inc	48
Ball Corp	156
Beckman Instruments Inc	75
Becton, Dickinson and Co	129
Bell Industries Inc	170
Black & Decker	117
Boeing Co., The	35
Bolt Beranek and Newman Inc	162
Borland International	110
Cabletron Systems Inc	163
Cadence Design Systems Inc	120
Chrysler Corp	63
Coherent Inc	194
Compaq Computer Corp	22
Computer Associates International Inc	49
Concurrent Computer Corp	176
Conner Peripherals Inc	45
Control Data Corp	54
Corning Inc	68
Cray Research Inc	72
CTS Corp	181
Cubic Corp	138
Cypress Semiconductor Corp	146
Data General Corp	56
Datapoint Corp	166
Dell Computer Corp	70
Diasonics Inc	150
Diebold Inc	104
Digital Equipment Corp	4
Dover Corp	97
DSC Communications Corp	101
DuPont, E I De Nemours & Co	34
Dynatech Corp	99
Eastman Kodak Co	17
Eaton Corp	69
EG&G Inc	78
Eli Lilly and Co	88
EMC Corp	177
Emerson Electric Co	36
Emerson Radio Corp	79
ESCO Electronics Corp	122
Esterline Corp	183
Everex Systems	96
Exabyte	176
Executone Information Systems Inc	159
E-Systems Inc	39
Figgie International Inc	188
Fischer & Porter Co	199
Fisher Scientific International Inc	100
Fluke Mfg. Co., John	174
Ford Motor Co	33
General Dynamics Corp	65
General Electric Co	8
General Signal Corp	80
Genicom Corp	189
Gerber Scientific Inc	167
GM Hughes Electronics Corp	6
Grumman Corp	61
GTE Corp	30
Harnischfeger Industries Inc	190
Harris Corp	26
Hewlett-Packard Co	3
Honeywell Inc	12
Hubbell Inc	178
IBM	1
Imo Industries Inc	135
Inmac Corp	140
Integrated Device Technology Inc	200
Intel Corp	14
Intergraph Corp	57
International Rectifier Corp	168
ITT Corp	32
Johnson Controls Inc	47
Kodiag Inc	154
Legent Corp	191
Litton Industries Inc	24
Lockheed Corp	18
Logicon Inc	147
Loral Corp	27
Lotus Development Corp	76
LSI Logic Corp	84
LTV Corp., The	133
MAI Systems Corp	151
Mark IV Industries Inc	89
Marshall Industries	90
Martin Marietta Corp	25
Maxtor Corp	66
McDonnell Douglas Corp	42
Measurex Corp	169
Medtronic Inc	71
Mentor Graphics Corp	118
Mensel Inc	46
Micron Technology Inc	103
Micropolis Corp	128
Microsoft Corp	38
Millipore Corp	161
Molex Inc	81
Monsanto Co	106
Motorola Inc	7
M/A-COM Inc	121
National Semiconductor Corp	44
Northrop Corp	73
Novell Inc	83
Olin Corp	153
Oracle Systems Corp	59
Penn Central Corp	111
Perkin-Elmer Corp., The	82
Pioneer-Standard Electronics Inc	124
Pitney Bowes Inc	37
Pittway Corp	145
Polaroid Corp	112
Premier Industrial Corp	114
Pyramid Technology Corp	184
QMS Inc	143
Quantum Corp	60
Qume Corp	186
Raychem Corp	91
Raytheon Co	13
Read-Rite Corp	192
Reliance Electric Co	105
Reynolds and Reynolds Co., The	171
Rockwell International Corp	15
Savin Corp	139
SCI Systems Inc	64
Scientific Atlanta Inc	95
Seagate Technology Inc	21
Sensormatic Electronics Corp	157
Sequa Inc	127
Sequent Computer Systems Inc	195
Silicon Graphics Inc	87
Silicon Valley Group Inc	187
Smith Corona Corp	126
Solectron Corp	137
Sprague Technologies Inc	142
Storage Technology Corp	58
Stratus Computer Inc	107
Sun Electric Corp	185
Sun Microsystems Inc	20
Sundstrand Corp	144
Symbol Technologies Inc	136
SynOptics Communications Inc	173
Syntex Corp	197
Tandem Computers Inc	41
Tandon Corp	102
Tandy Corp	16
Tech Data Corp	86
Tektronix Inc	53
Teledyne Inc	74
Tellabs Inc	196
Telxon Corp	198
Teradata Corp	141
Teradyne Inc	93
Texas Instruments Inc	10
Textron Inc	172
Thermo Electron Corp	131
Thomas & Betts Corp	160
TRW Inc	28
Tyco Laboratories Inc	164
Unisys Corp	9
United Technologies Corp	51
Varian Associates Inc	50
Vishay Intertechnology Inc	108
VLSI Technology Inc	116
Wang Laboratories Inc	40
Watkins-Johnson Co	155
Western Digital Corp	67
Westinghouse Electric Corp	23
Westmark International Inc	94
Wyle Laboratories Inc	125
Xerox Corp	5
Zenith Electronics Corp	52
Zeos International Ltd	179

HOW Linear Technology gets the biggest bang for its R&D bucks

As leader of National Semiconductor's analog products group back in the late '70s and early '80s, Robert Swanson ran what was then the largest linear IC business in the industry. It was there, he claims, that he discovered one of the principles in the success of Linear Technology: the careful management of R&D spending.

Linear has grown to more than $100 million in revenue while posting profits that have made the company a darling on Wall Street. His philosophy is simple: All R&D spending is not an investment in the future—it can be a black hole just like other expenses and must be carefully managed to maximize results and avoid waste. So far, it works. Spending only 10% of sales, Linear leads the analog market in performance and posts 25% profit margins. Net sales for 1991 were $94.2 million with gross profit of $52.3 million.

By Hugh Willett

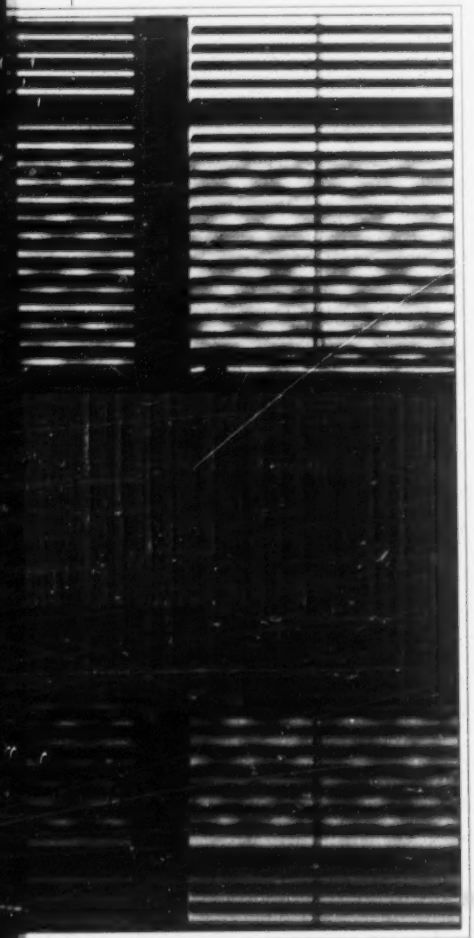
Photos by Jamie Tanaka

ELECTRONIC BUSINESS: How much does Linear spend on R&D?
ROBERT SWANSON: In fiscal 1992 we spent about $7.7 million, and in 1993 we'll spend about $10 million.

EB: What percentage of sales does this represent?
RS: It's about 10% of our total sales. We feel that spending 10% can generate the number of new products we need to keep sales growing at the rate we want to grow. We don't specifically try to spend 10%, but that is the rate that has worked out for us.

EB: The industry average is about 15%, and some companies such as Advanced Micro Devices have been spending 20% per year. Aren't you guys spending too little?
RS: I had the benefit of working at a company like National, and I saw that you could waste money in R&D programs—a lot of money. R&D is a part of the P&L, just like marketing or other expenses that have to be managed carefully.

EB: Isn't R&D spending an investment in the future?
RS: It should be, but look at it this way: Gross profits are about 50% in this business. If you're trying to get 25% profit on the bottom line, which is what you need to survive after your 15% SG&A expenses, that doesn't leave more than 10% for R&D. I could spend more, but it would have to come off my bottom line. That's not a formula for success.



EB: What is the average return on investment in R&D for Linear?
RS: We want to see $1 million to $3 million in sales over two years for each new product. Some will do $5 million.

EB: How does this compare with others in your industry?
RS: A lot of companies in the analog business are happy to get $300,000 to $400,000 per year in sales from a product. We call those "turkeys" in our organization, and they make up less than 5% of our new products.

EB: Are there other ways to measure the progress of your investments?
RS: We can look at incremental sales two years after the investments are made. In fiscal 1987 we spent $3.3 million on R&D and in 1989 we grew sales by $13 million. That's a multiple of 3.9.

EB: How many new products come out of your R&D effort each year?
RS: Anywhere from 50 to 90. We have about 35 circuit designers plus process engineers and managers for a total R&D staff of about 75, or less than 10% of our 850 employees worldwide.

EB: How do you get such high levels of productivity out of such a small number of engineers?
RS: Each designer is working on two or three designs at a time. The analog design is more of an individual effort than a digital design. We try to establish a strong sense of ownership between a designer and the new product. The culture at Linear gives them a lot of freedom in how they design, but they're accountable for the success of the product. If it sells, you're a hero. If it doesn't, you're a bum.

EB: How many projects are considered for funding each year, and how many are actually funded?
RS: We might look at hundreds of good ideas, but we can implement only as many of them as our design resources will allow. We are constantly reprioritizing, looking at the list of projects and adding to it or taking something off the list. Designers could be working on three projects at once, or they could be working on just one if it has a high priority.

EB: If the designs are going to produce millions in revenue, why don't you just expand your design group and make more money?
RS: We have $95 million in the bank, so it's not a matter of not having the money to fund everything we'd like to design. There are natural limits.

EB: What kind of limits?
RS: Finding really talented design engineers. We don't want just good designers, we want great ones. That's how you maximize the return on R&D dollars. We're like the Marines—looking for a few good men.

EB: How long is a typical product development cycle?
RS: It can be anywhere from one to three years. Even though our customers' product life cycles are accelerating, the products we are designing are getting more complicated so

our design cycle is getting longer.

EB: Doesn't that fly in the face of the "time-to-market" race that seems to have everyone in the chip business so concerned?
RS: Our products will typically have a three-year lifespan. We are always working to improve the design, but one product—if it's the best in the industry—may serve our customers through several generations of their own products.

EB: Isn't it hard to closely track return on investment if it takes several years to realize the full return?
RS: We make our yearly investments based on a consistent philosophy. What I spent two years ago, I expect to see in my sales this year.

EB: How does the process work?
RS: We exploit our field applications engineers. They're out talking to the customer, finding out what he needs, and planting seeds for the future. They submit written reports, and those reports are critiqued by a team that includes myself and Bob Dobkin, our director of design.

EB: Do the design engineers participate in the selection process?
RS: Our design engineers also travel a lot; we don't keep them locked away. We want them out talking to the customer so they know what kind of problems the customer is facing. We don't try to insulate our designers from the customer the way a lot of companies do. Our customers can pick up a phone any time and get one of our designers on the line.

EB: How does customer input turn into product ideas?
RS: Every week we have a meeting to sort through the reports from the field. That information is used to add features or performance to projects underway and to give us ideas for new products.

EB: How do you decide which ideas to keep?
RS: We're in the analog business, but so are about 50 other companies. We don't want to pick new products just because we know there will be a market for them, because everybody else is going to be targeting those same markets. We look for the ideas that play to our strengths in performance—low power and so on. Those are the cream that we want to skim off. The other ideas might be good, but they're down in the milk, and we don't want to play down there.

EB: How do you know which products will play to Linear's strengths?
RS: We bring everyone into the process, from the design engineers to marketing and process development and test people. We want to design to the edge of the envelope. The designer needs to communicate with the process engineer to know what kind of performance capabilities will be available a year from now. The process engineer needs to know what he'll have to be able to put in silicon in the future.

EB: Are investments in process R&D as important as in design R&D?
RS: Yes, very much so. We have our own fab because it's an asset that we rely on to provide the highest performance parts. The process engineers need to know the exact requirements so we don't over-invest.

EB: How do you over-invest?
RS: A lot of companies in the analog business spend a lot of money on process technology hoping they'll discover some magic formula. They don't know exactly what they want so they spend money to find out.

EB: How is Linear different?
RS: We find out exactly what we need before we spend. The analog business doesn't require the tightest geometries. We're making leading-edge products with 2-micron processes. That may not sound high-tech to the digital world, but it's adequate for analog. We don't want to go to submicron just to brag that we have a submicron process. Our process investments are geared to low power and high speed.

EB: Besides process and design, where else do you spend R&D money?
RS: Packaging is one area where we try to distinguish ourselves. We find out what the customer requirements are and design to those needs. □

TOP 100 R&D SPENDERS

The top 100 R&D spenders keep on spending

Despite last year's recession, the top 100 spenders on research and development actually plowed more *into R&D—both in terms of total dollars spent (from $21.2 billion in 1990 to $21.7 billion in 1991) and as a share of their sales (from 9.0% to 9.3%). Companies that boosted R&D spending significantly include Symbol Technologies (up 210%), Ask Computer Systems (81%), and Diebold (72%). For the complete listing of the ELECTRONIC BUSINESS top 100 R&D spenders,* *see page* 101.

TOP 100 R&D SPENDERS

Rank 1991	Rank 1990	Company Location	R&D as a percentage of sales	R&D spending ($ millions)	R&D spending (% change)	1991 sales ($ millions)	% change from 1990	1991 net income ($ millions)	% change from 1990	Fiscal year
1	2	**Integrated Device Technology Inc.** Santa Clara,Calif.	25.6%	$50.8	22.1%	$198.6	-5.2%	$1.2	-92.8%	3/91
2	1	**Cypress Semiconductor Corp.** San Jose,Calif.	25.0	71.8	29.2	286.8	27.3	34.2	2.8	12/91
3	6	**Mentor Graphics Corp** Wilsonville,Ore.	19.9	79.5	6.7	400.1	-8.1	-61.6	NM	12/91
4	18	**Amdahl Corp.** Sunnyvale,Calif.	18.4	312.5	0.8	1,702.5	-21.1	4.4	-97.6	12/91
5	15	**Tellabs Inc.** Lisle,Ill.	17.5	37.2	17.8	212.8	0.8	6.6	-18.2	12/91
6	3	**Advanced Micro Devices Inc.** Sunnyvale,Calif.	17.4	213.8	5.0	1,226.6	15.8	145.3	NM	12/91
7	4	**Cadence Design Systems Inc.** San Jose,Calif.	17.4	68.3	60.4	392.3	69.5	-21.7	NM	12/91
8	8	**Analog Devices Inc.** Norwood,Mass.	16.6	89.0	10.8	537.7	10.8	8.2	NM	10/91
9	10	**Cray Research Inc** Eagan,Minn.	16.4	141.3	10.0	862.5	7.2	113.0	0.0	12/91
10	7	**Applied Materials Inc.** Santa Clara,Calif.	16.1	102.7	5.8	638.6	12.6	26.2	-23.0	10/91
11	19	**Stratus Computer Inc.** Marlborough,Mass.	15.5	69.7	21.3	448.6	11.1	49.7	34.4	12/91
12	27	**Concurrent Computer Corp.** Oceanport,N.J.	14.9	38.1	-11.6	254.9	-25.0	-66.8	NM	6/91
13		**Adobe Systems Inc** Mountain View,Calif.	14.5	33.2	64.4	229.7	36.1	51.6	28.8	11/91
14	25	**Teradata Corp** El Segundo,Calif.	14.4	37.2	27.6	257.8	15.0	-2.4	NM	6/91
15	14	**Lotus Development Corp.** Cambridge,Mass.	14.1	116.6	13.6	828.9	21.1	43.1	85.4	12/91
16	22	**Tandem Computers Inc.** Cupertino,Calif.	13.9	266.6	5.1	1,922.2	3.0	35.2	-71.1	9/91
17	45	**DSC Communications Corp.** Plano,Tex.	13.8	63.8	23.3	461.5	-11.1	-108.3	NM	12/91
18	9	**VLSI Technology Inc** San Jose,Calif.	13.2	54.4	1.6	413.4	27.3	9.9	NM	12/91
19	23	**Computer Associates Intl. Inc** Garden City,N.Y.	13.2	177.4	3.6	1,348.2	4.0	159.3	1.0	3/91
20		**SynOptics Communications Inc** Santa Clara,Calif.	13.1	32.4	15.4	248.3	41.1	26.8	-5.1	12/91
21		**Tektronix Inc** Beaverton,Ore.	12.9	172.4	-11.4	1,330.9	-5.5	48.3	NM	5/91
22	24	**Intel Corp.** Santa Clara,Calif.	12.9	618.0	19.6	4,778.6	21.9	818.6	25.9	12/91
23	21	**Silicon Valley Group Inc** San Jose,Calif.	12.8	30.0	18.6	234.8	27.4	1.6	-63.1	9/91
24	12	**Microsoft Corp.** Redmond,Wash.	12.8	235.4	30.3	1,843.4	55.8	462.7	65.7	6/91
25	44	**Autodesk Inc.** Sausalito,Calif.	12.7	34.8	42.6	274.0	15.2	57.8	1.8	1/92
26	35	**Coherent Inc.** Palo Alto,Calif.	12.6	26.1	19.0	207.8	8.7	0.2	NM	9/91
27	17	**Teradyne Inc.** Boston,Mass.	12.2	62.0	-7.3	508.9	10.9	18.3	NM	12/91
28	32	**Novell Inc.** Provo,Utah	12.2	77.9	31.4	640.1	28.7	162.5	72.3	10/91
29	42	**Sequent Computer Systems Inc.** Beaverton,Ore.	12.1	25.8	0.0	213.3	-14.3	-48.7	NM	12/91
30	31	**Bolt Beranek and Newman Inc.** Cambridge,Mass.	12.0	32.5	2.9	270.6	3.3	9.1	NM	6/91
31	33	**Westmark International Inc.** Seattle,Wash.	11.9	60.1	5.4	504.7	4.1	21.4	30.5	12/91
32	37	**Silicon Graphics Inc.** Mountain View,Calif.	11.9	65.3	43.0	549.9	31.0	32.9	2.1	6/91
33	29	**Digital Equipment Corp.** Maynard,Mass.	11.9	1,649.4	2.2	13,911.0	7.5	-617.4	NM	6/91
34	13	**National Semiconductor Corp.** Santa Clara,Calif.	11.7	198.6	-21.3	1,701.8	1.6	-150.3	NM	5/91
35	53	**LSI Logic Corp.** Milpitas,Calif.	11.6	80.8	34.2	697.8	6.5	8.3	NM	12/91
36	40	**3Com Corp.** Santa Clara,Calif.	11.4	45.4	4.0	398.6	-4.9	-27.7	NM	5/91
37	39	**Intergraph Corp.** Huntsville,Ala.	11.2	134.4	22.1	1,195.4	14.4	71.1	13.7	12/91
38	55	**Wang Laboratories Inc** Lowell,Mass.	11.2	233.6	5.3	2,091.5	-16.2	-377.9	NM	6/91
39	30	**Sun Microsystems Inc.** Mountain View,Calif.	11.1	356.6	18.1	3,221.3	30.6	190.3	71.1	6/91
40	48	**ADC Telecommunications Inc.** Minneapolis,Minn.	11.0	32.3	26.9	293.8	13.1	22.0	-3.8	10/91
41	47	**Dynatech Corp.** Burlington,Mass.	10.7	51.7	21.8	481.5	11.1	15.6	5.7	3/91
42	36	**Pyramid Technology Corp.** Mountain View,Calif.	10.7	24.3	19.8	227.9	26.8	12.0	-28.5	9/91
43	49	**IBM** Armonk,N.Y.	10.3	6,644.0	1.4	64,792.0	-6.1	-564.0	NM	12/91
44	43	**Hewlett-Packard Co** Palo Alto,Calif.	10.1	1,463.0	7.0	14,494.0	9.5	755.0	2.2	10/91
45	73	**Scientific Atlanta Inc.** Atlanta,Ga.	10.0	49.2	23.8	493.7	-19.6	1.1	-97.6	6/91
46	64	**Watkins-Johnson Co** Palo Alto,Calif.	9.8	27.2	10.9	277.5	-11.0	-22.4	NM	12/91
47	28	**Borland International Inc.** Scotts Valley,Calif.	9.8	22.2	54.8	226.8	100.2	26.8	127.2	3/91
48	50	**Acuson Corp.** Mountain View,Calif.	9.7	32.7	21.8	336.3	18.9	58.5	22.3	12/91
49	46	**Beckman Instruments Inc.** Fullerton,Calif.	9.6	82.2	2.0	857.9	5.2	38.1	5.2	12/91
50	52	**Motorola Inc.** Schaumburg,Ill.	9.5	1,079.0	7.0	11,341.0	4.2	454.0	-9.0	12/91

NM = not meaningful

(Continued)

TOP 100 R&D SPENDERS

Rank 1991	Rank 1990	Company Location	R&D as a percentage of sales	R&D spending ($ millions)	R&D spending (% change)	1991 sales ($ millions)	1991 sales % change from 1990	1991 net income ($ millions)	1991 net income % change from 1990	Fiscal year
51	58	**Apple Computer Inc.** Cupertino,Calif.	9.2%	$583.0	22.0%	$6,308.8	13.5%	$309.8	-34.8%	9/91
52	67	**Measurex Corp.** Cupertino,Calif.	9.1	23.0	13.6	254.0	-4.6	0.4	-98.3	11/91
53		**Exabyte Corp.** Boulder,Co.	9.0	21.1	49.2	234.1	37.5	32.2	16.7	12/91
54	59	**Fluke Mfg. Co., John** Everett,Wash.	8.8	21.1	6.4	239.7	2.5	3.2	-73.7	9/91
55	51	**Medtronic Inc.** Minneapolis,Minn.	8.8	89.5	12.8	1,021.4	22.1	133.4	22.7	4/91
56	63	**Ask Computer Systems Inc.** Mountain View,Calif.	8.7	29.9	80.8	343.9	65.8	2.7	-46.7	6/91
57	56	**AMP Inc.** Harrisburg,Pa.	8.6	265.0	0.8	3,095.0	1.7	259.7	-9.5	12/91
58	98	**Symbol Technologies Inc.** Bohemia,N.Y.	8.5	27.0	210.4	319.4	38.0	22.8	200.5	12/91
59	38	**Micron Technology Inc.** Boise,Idaho	8.4	35.8	0.4	425.4	27.6	5.1	3.5	8/91
60	65	**Western Digital Corp.** Irvine,Calif.	8.4	83.0	1.1	986.2	-7.9	-134.2	NM	6/91
61	72	**Gerber Scientific Inc.** South Windsor,Conn.	8.3	22.3	7.7	268.4	-12.6	8.0	-75.4	4/91
62	34	**Data General Corp.** Westboro,Mass.	8.3	102.0	-27.5	1,228.9	1.0	85.6	NM	9/91
63	60	**Applied Magnetics Corp** Goleta,Calif.	8.2	37.3	19.6	455.5	23.6	-18.3	NM	9/91
64		**Legent Corp.** Vienna,Virg.	8.2	16.6	16.0	203.3	19.9	33.9	3.0	9/91
65	74	**Everex Systems** Fremont,Calif.	8.1	34.2	23.5	425.1	-2.6	-48.0	NM	7/91
66	54	**Oracle Systems Corp.** Redwood Shores,Calif.	8.0	82.7	-6.3	1,027.9	5.9	-12.4	NM	5/91
67		**EMC Corp.** Hopkinton,Mass.	7.9	18.4	24.3	232.4	35.7	13.0	47.2	12/91
68	69	**Control Data Corp.** Minneapolis,Minn.	7.8	119.1	-6.3	1,524.9	-9.8	-8.6	NM	12/91
69	61	**Texas Instruments Inc.** Dallas,Tex.	7.8	527.0	-2.4	6,784.0	3.3	-409.0	NM	12/91
70	66	**Archive Corp.** Costa Mesa,Calif.	7.7	26.5	18.9	345.6	17.9	-49.3	NM	9/91
71	68	**Perkin-Elmer Corp., The** Norwalk,Conn.	7.5	65.9	4.0	874.4	4.4	-2.6	-105.8	7/91
72	57	**Storage Technology Corp.** Louisville,Colo.	7.5	118.8	20.8	1,584.9	39.0	93.1	31.8	12/91
73		**Cabletron Systems Inc.** Rochester,N.H.	7.4	13.3	72.7	180.5	72.3	35.9	60.7	2/91
74	70	**Unisys Corp.** Blue Bell,Pa.	7.3	638.9	-14.4	8,696.1	-14.0	-1,393.3	NM	12/91
75	95	**Diebold Inc.** Canton,Ohio	6.9	35.0	72.4	506.2	6.3	35.7	31.8	12/91
76	84	**Micropolis Corp.** Chatsworth,Calif.	6.9	24.1	18.3	350.9	-7.8	4.3	-45.2	12/91
77		**Komag Inc.** Milpitas,Calif.	6.5	18.0	42.8	279.2	55.2	17.2	13.4	12/91
78	75	**Xerox Corp** * Stamford,Conn.	6.4	890.0	5.0	13,819.0	1.7	436.0	-27.2	12/91
79	76	**Diasonics Inc.** Milpitas,Calif.	6.4	18.3	10.9	286.5	7.3	18.9	15.1	12/91
80		**Telxon Corp.** Akron,Ohio	6.3	11.6	12.2	184.6	28.7	12.3	NM	3/91
81	71	**Maxtor Corp.** San Jose,Calif.	6.2	54.3	52.6	871.3	77.4	-45.4	NM	3/91
82	78	**Varian Associates Inc.** Palo Alto,Calif.	6.0	83.4	7.7	1,377.9	8.9	57.5	356.4	9/91
83	85	**Compaq Computer Corp.** Houston,Tex.	6.0	197.3	6.2	3,271.4	-9.1	130.7	-71.3	12/91
84	81	**Atari Corp.** Sunnyvale,Calif.	5.9	15.3	-33.1	258.0	-37.3	23.7	NM	12/91
85	82	**Molex Inc.** Lisle,Ill.	5.7	40.7	24.2	708.0	19.1	64.6	4.1	6/91
86	89	**Augat Inc.** Mansfield,Mass.	5.7	16.0	17.6	281.6	-5.9	-22.1	NM	12/91
87	86	**GM Hughes Electronics Corp.** Detroit,Mich.	5.5	634.9	11.8	11,540.6	-1.6	381.1	-34.0	12/91
88		**Fischer & Porter Co.** Warminster,Penn.	5.4	12.8	-3.8	237.0	-0.4	-22.5	-176.5	12/91
89	88	**Conner Peripherals Inc.** San Jose,Calif.	5.3	85.0	35.2	1,599.0	19.5	92.5	-28.9	12/91
90	93	**Seagate Technology Inc.** Scotts Valley,Calif.	5.1	137.5	32.1	2,677.0	10.9	62.8	-46.4	6/91
91	83	**Loral Corp.** New York,N.Y.	5.0	105.3	50.4	2,126.8	66.9	90.4	16.5	3/91
92	80	**Quantum Corp.** Milpitas,Calif.	4.9	43.3	67.8	877.7	96.7	73.9	56.5	3/91
93	77	**Andrew Corp.** Orland Park,Ill.	4.9	20.3	-9.9	416.2	13.7	22.2	22.1	9/91
94	90	**Honeywell Inc.** Minneapolis,Minn.	4.9	300.7	7.5	6,192.9	-1.8	333.1	-10.4	12/91
95	92	**Esterline Corp.** Bellevue,Wash.	4.7	16.6	-2.3	350.9	-9.8	7.3	3.6	10/91
96	87	**Harris Corp.** Melbourne,Fla.	4.4	135.1	-7.0	3,040.1	-0.4	19.5	-85.1	6/91
97		**M/A-Com Inc.** Wakefield,Mass.	4.4	16.8	30.1	382.1	2.0	17.0	NM	9/91
98	97	**Zenith Electronics Corp.** Glenview,Ill.	4.1	54.1	-3.2	1,321.6	-6.3	-51.6	NM	12/91
99	99	**Qume Corp.** Milpitas,Calif.	4.0	8.6	4.6	217.8	-2.0	-19.6	NM	2/91
100	100	**AST Research Inc.** Irvine,Calif.	3.9	26.6	44.5	688.5	29.0	64.7	84.6	6/91

NM = not meaningful — *Data processing operations only — % change=% change from fiscal 1990

Contract manufacturing looks to higher quality, lower costs

The drive to the Baldrige and ISO 9000 certification may be the engine for growing the industry by 15% this year

By Alberto Socolovsky

The next time the U.S. launches a Tomahawk cruise missile, it will be guided by circuits fabricated by a contract manufacturer. The result: a lower-cost Tomahawk that will have lost none of its deadly accuracy.

Farming out electronics manufacturing is a first for the Tomahawk program, although it's been done for years in the computer industry, the largest market for contract manufacturing. For military and computer OEMs, the trend is toward more contracting. Market specialist Technology Forecasters in Berkeley, Calif., puts worldwide growth of electronic contract services at 9% in 1991, for a total of $15.8 billion—$6.8 billion in North America. It expects this market to grow at least 15% in 1992.

As with the Tomahawk, contractors help OEMs achieve manufacturing quality at competitive prices. Their drive for quality was recognized last year when one of the majors, Solectron Corp. in Milpitas, Calif., won the 1991 Malcolm Baldrige National Quality Award in the "large manufacturing" category.

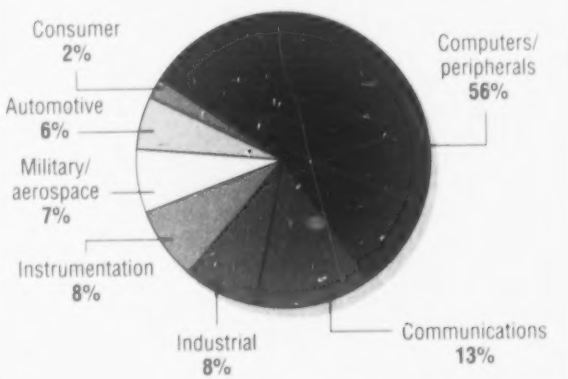
Quality, plus the expanding services these companies provide to OEM customers, has upgraded contract manufacturers' profile among OEMs. "We got rid of cable assemblies, sub-assembly . . . we even let our subcontractors put our box around [our computers and] ship directly to our customers," says Sun Microsystems chairman Scott McNealy, explaining the strategy that has halved manufacturing costs from the days when Sun did its own manufacturing. Sun is Solectron's major customer, followed by IBM. Both computer companies have partnering agreements with Sun that include technology sharing, early involvement in product plans, and concurrent engineering.

"Contract manufacturing" has become too restrictive a term to represent the range of services and partnerships that are becoming the norm. The Institute for Interconnecting and Packaging Electronic Circuits (IPC) in Evanston, Ill., calls them "electronic manufacturing services" (EMS) and has gathered under its wing a group of 150 such companies, including the four largest.

For the time being, the push for standards in the EMS industry comes from the European Community. Starting next year, products sold in the EC must have been assembled by plants certified as qualifying under the framework of ISO 9000, a set of guidelines for documenting quality production practices (see "Behind the facade of ISO 9000," ELECTRONIC BUSINESS, p. 40, Jan. 27, 1992). SCI Systems' plant in Huntsville, Ala., and Flextronics International's plant in Singapore have already been certified for ISO 9002, a certification level that provides a QA model for production and installation. Most EMS companies are gearing to have all their European and Southeast Asian plants cer-

Contract manufacturing tied to computer industry

(Share of total revenue by market segments, 1991)



Source: Technology Forecasters

tified for this standard by the end of 1992. Factories, usually at headquarters, that also provide design services must qualify for ISO 9001, a broader standard that includes QA in design and development.

Not only must plants be certified individually, notes a Flextronics source, but certification is handled by a different standards organization from each country. Thus, an OEM that wants to sell in Europe must ensure that the factory that manufactures its equipment has been certified.

The 1991 recession and the investment required in the latest assembly technologies have taken their toll on some of the smaller contractors. On the other hand, the need to put idle capacity to work has attracted the largest captive manufacturer into the EMS arena. "Thanks to our increase in [manufacturing] quality and productivity," says Pat Toole, IBM's senior vice president for manufacturing and development, "we've more capacity than we can use." Big Blue is offering printed circuit card assembly and test services at its modern Austin, Tex., plant which assembles circuit cards for its PCs and workstations.

Austin conceivably could compete with IBM's scores of EMS suppliers, from SCI Systems to such smaller players as Zercom Corp. in Merifield, Minn. Actually, each contractor brings to the party a definite skill or advantage. Philips Circuit Assemblies offers the high-speed production equipment and technology of its Dutch parent. Texas Instruments' Custom Manufacturing Services boasts quick implementation of the latest semiconductor technology.

"Contractors accounted for 37% of the U.S. purchases of production equipment for surface mounting in 1991, a tremendous jump over 1990," says electronics assembly consultant Charles-Henri Mangin of Ceeris International in Old Lyme, Conn. As for newer assembly technologies in which many EMS companies expect to lead—such as tape-automated bonding (TAB), C-IV (a high density flip-chip method developed by IBM), and multichip modules (MCMs)—Mangin cautions that these companies are still in early development. Most of the new half-million dollar production machines sold in 1991 went to captive producers, he says, including Apple, AT&T, IBM, and Sun Microsystems. □

The U.S. leaders in contract manufacturing

1991 sales ($ millions)	
SCI Systems	$1,128
Solectron	265
Avex Electronics	260
Jabil Circuit	232
Philips Circuit Assembly	150

Source: Technology Forecasters

Does winning a Baldrige pay off on the bottom line?

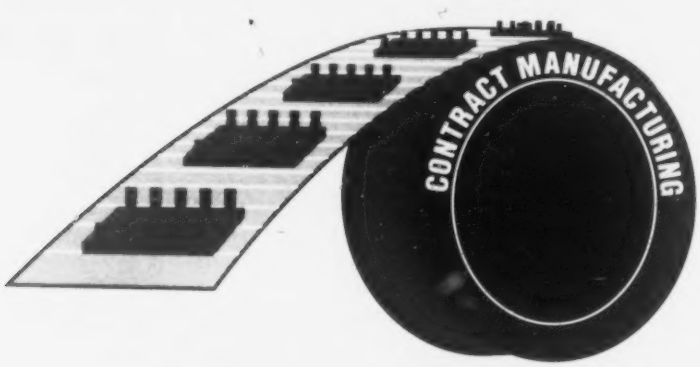
Solectron's win of the prestigious Malcolm Baldrige National Quality Award last year has not sent OEMs rushing to switch their production from in-house to a contractor, but it reinforces the feeling that contracting is the trend for the future.

"It doesn't do any harm," says Olin B. King, chairman of industry leader SCI Systems. "[The award] is important, but customers question what it means." He notes that one of the 1990 winners (Wallace Inc., a small petrochemical services company) is now in Chapter 11. SCI Systems—as well as most EMS companies, including Solectron—has concentrated on ISO 9000. "We've qualified all of our European and East Asian plants," say King. "In the long term, a contractor won't be able to compete unless he's qualified to ISO 9000."

Like many EMS companies, IEC Electronics Corp. in Newark, N.Y., follows the Baldrige criteria for quality without actually applying. "The criteria are excellent," says executive vice president Russell Stingel, "but the award has a high cost of entry." ETMA's executive vice president John Rapp explains that he had to hire two people to document the ISO process. "You need even more manpower for Baldrige."

Solectron's customers see their supplier's award as contributing to their own quality programs. At IBM, whose Rochester division itself won in 1990, director of worldwide procurement Albert Cicman says that "a key ingredient of the company's defect elimination plan is to establish and maintain a set of suppliers capable of providing parts, products, and services of the highest quality." At Exabyte in Boulder, Colo., a manufacturer of computer tape backup systems, senior vice president of operations Frank LaHue says his company's interaction with award winners is not only through Solectron, but also through Exabyte's customers Motorola (1988), Xerox (1989), and IBM (1990). "The [Baldrige] process points out areas where we can improve," says LaHue, "but the award requires more structure than we'd like." He appreciates the time that Solectron's top executives Winston Chen and Koichi Nishimura have spent addressing Exabyte's manufacturing people, but wonders about the time that executives of a winning company must spend on the road spreading the Baldrige gospel.

Nishimura defends Solectron's investment in the Baldrige. "We didn't apply to win," he explains, "but as a process to improve the company. It gave us the ability to benchmark. Baldrige helps make a better company." Still, more important than Baldrige, says Nishimura, "are the 43 customer awards we have won. They bring in the revenue." □



Contract manufacturing directory

Over $50 million in revenue

Avex Electronics
4807 Bradford Dr. Huntsville, AL 35805 Brian Throneberry Phone: (205) 722-6000 Fax: (205) 722-6232 Space: 574,000 a,b,c,d,e

Cerberus Pyrotronics
8 Ridgedale Ave. Cedar Knolls, NJ 07927 George Snedecor Phone: (201) 397-7272 Fax: (201) 397-7008 Space: 170,000 a,b,c,d,e Customers: Siemens, Bogen, Wells Fargo

Compas
100 Chimney Point Dr. Ogdensburg, NY 13669 Edward Gilbert Phone: (315) 393-3573 Fax: (315) 393-7638 Space: 150,000 b,c,d,e Customers: Stratus Computer, IBM, Kodak

Comptronix
1800 Gunter Ave. Guntersville, AL 35976 Allen Shifflett Phone: (205) 582-1800 Fax: (205) 582-1817 Space: 500,000 a,b,c,d,e Customers: General Electric, NCR, Ampex, Northern Telecom

Corinth Telecommunications
Fulton Dr. Corinth, MS 38834 Bob Webb Phone: (601) 287-3771 Fax: (601) 287-1437 Space: 351,000 b,c,d,e,f Customers: IBM, Exide Elec., Gilbert Industries

CP Clare
3101 W. Pratt Ave. Chicago, IL 60645 Harsh Koppula Phone: (312) 262-7700 Fax: (312) 262-7819 Space: 120,000 b,c,d,f Customers: Texas Instruments

Dover Electronics-Eastern Div.
Kirkwood Industrial Park #5212 Binghamton, NY 13902 Robert P. Egan Phone: (607) 772-7563 Fax: (607) 772-0868 Space: 150,000 a,b,c,d,e

Type of service

- **a** Design
- **b** Product assembly
- **c** Turnkey manufacturing
- **d** Testing
- **e** Surface mount
- **f** Cable assembly

Dover Electronics-Western Div.
1198 Boston Ave. Longmont, CO 80501 Brent Solman Phone: (303) 772-5933 Fax: (303) 776-1883 Space: 45,000 a,b,c,d,e Customers: IBM, TRW, ISC-Bunker Ramo

Elamex
Box 10438 El Paso, TX 79995 Fred Mitchell Phone: (915) 592-1991 Fax: (915) 595-0155 Space: 800,000 b,c,d,e,f Customers: Polaroid, AT&T, Siemens

EMD Associates
4065 Theurer Blvd. Winona, MN 55987 Beth Eichman Phone: (507) 452-8932 Fax: (507) 452-5510 Space: 105,000 a,b,c,d,e

Flextronics International
48001 Fremont Blvd. Fremont, CA 94538 Sue Mucha Phone: (510) 226-3539 Fax: (510) 226-3535 Space: 300,000 a,b,c,d,e Customers: Octocom, Diebold, Logitech

GSS/Array Technology
1297 Parkmoor Ave. San Jose, CA 95126 John G. Waters Phone: (408) 999-5500 Fax: (408) 999-5565 Space: 175,000 a,b,c,d,e Customers: Maxtor, Rosemont, ICI

Group Technologies
10901 Malcolm McKinley Dr. Tampa, FL 33612 Jack Calderon Phone: (813) 972-6328 Fax: (813) 972-6715 Space: 308,000 a,b,c,d,e,f Customers: McDonnell Douglas, General Electric, Northrop

IBM/Charlotte
1001 W. Harris, #10-A, 201 Charlotte, NC 28257 Phone: (704) 594-1300 Fax: (704) 594-4950 Space: 150,000 a,b,c,d,e,

IEC Electronics
105 Norton St. Newark, NY 14513 Russell E. Stingel Phone: (315) 331-7742 Fax: (315) 331-3547 Space: 300,000 b,c,d,e,f Customers: IBM, Xerox, Compaq

Intl. Microelectronic Products
2830 N. First St. San Jose, CA 95134 John Wooaman Phone: (408) 432-9100 Fax: (408) 434-5904 Space: 81,000 a,b,c,d,e

Micron Custom Mfg. Services
8455 Westpark St. Boise, ID 83704 Steve Laney Phone: (208) 368-2600 Fax: (208) 368-2758 Space: 52,000 a,b,c,d,e Customers: IBM, Northern Telecom

PCI
1530 Parkmoor Ave. #A San Jose, CA 95128 Michael T. Clarke Phone: (408) 282-0200 Fax: (408) 282-0216 Space: 400,000 a,b,c,d,e Customers: Xerox, AT&T, Ford

Philips Circuit Assemblies
3602 W. Waters Ave. Tampa, FL 33614 Carol Maslona Phone: (813) 933-5113 Fax: (813) 933-7248 Space: 200,000 a,b,c,d,e

continued

Philips Micro Electronics
2601 South Moorland Rd. New Berlin, WI 52151 Don Weiland Phone: (414) 785-6364 Fax: (414) 785-6517 Space: 85,000 a,b,c,d,e Customers: AT&T, Hewlett-Packard, Allen Bradley

Philips Technologies-Automotive
813 S. Grandstaff Dr. Auburn, IN 46706 Harold Griswold Phone: (219) 925-8774 Fax: (219) 925-8710 Space: 100,000 b,c,d,e Customers: Harley Davidson, OMC

Plexus
55 Jewelers Park Dr. Neenah, WI 54957 Chuck Williams Phone: (414) 722-3451 Fax: (414) 722-4155 Space: 315,000 a,b,c,d,e,f Customers: IBM, General Electric

SCI Systems
13000 S. Memorial Pkwy. Huntsville, AL 35807 Michael Reale Phone: (205) 882-4400 Fax: (205) 882-4871 Space: 2,500,000 a,b,c,d,e,f Customers: IBM, Conner, Seagate

Solectron
777 Gibraltar Dr. Milpitas, CA 95035 Ed Hayes Phone: (408) 957-8500 Fax: (408) 956-6075 Space: 650,000 a,b,c,d,e Customers: Sun, IBM, Exabyte

Sparton Electronics Mfg.
30167 Powerline Rd. Brooksville, FL 34602 Alan Houghtaling Phone: (904) 799-6520 Fax: (904) 796-7482 Space: 120,000

Teledyne Lewisburg
1425 Higgs Rd. Lewisburg, TN 37091 John Murphy Phone: (615) 359-4531 Fax: (615) 359-2085 Space: 155,000 a,b,c,d,e,f Customers: Hughes, IBM, GE Westinghouse

Texas Instruments
Box 6102 Temple, TX 76503 Robert Gilbert Phone: (800) 232-3200 Fax: (817) 774-6703 Space: 4,000,000 a,b,c,d,e

Varian Tempe Electronics Center
615 S. River Dr. Tempe, AZ 85258 Ken Muller Phone: (602) 968-6790 Fax: (602) 894-5381 Space: 55,000 a,b,c,d,e

Type of service

- **a** Design
- **b** Product assembly
- **c** Turnkey manufacturing
- **d** Testing
- **e** Surface mount
- **f** Cable assembly

XETEL 8100 Cameron Rd.
Austin, TX 78753 Mark Trutna Phone: (512) 834-2266 Fax: (512) 834-9250 Space: 60,000 a,b,c,d,e Customers: Motorola, PictureTel, Kentek

$20 million to $50 million in revenue

AJ Electronics
20945 Plummer St. Chatsworth, CA 91311 Eugene Plantier Phone: (818) 998-8788 Fax: (818) 407-9440 Space: 48,000 a,b,c,d,e,f

ASD
Industry St. Poughkepsie, NY 12603 Harry J. Kane Phone: (914) 473-5530 Fax: (914) 454-2538 Space: 220,000 a,b,c,d,e,f Customers: IBM, Pitney Bowes, N.J. Turnpike Authority

Benchmark Electronics
802 West Brazospark Dr. Clute, TX Steven McGill Phone: (409) 265-0991 Fax: (409) 265-7804 Space: 65,000 a,b,c,d,e Customers: Intel, Siemens, AT&T

Electronic Fab Technology
7251 W. 4th St. Greeley, CO 80634 Wayne Cusick Phone: (303) 353-3100 Fax: (303) 893-5009 Space: 50,000 b,c,d,e,f Customers: Hewlett-Packard, Ohmeda, Colorado Memory Systems

EOG
10947 Golden West Dr. Hunt Valley, MD 21030 Arthur Rutledge Jr. Phone: (301) 785-3000 Fax: (301) 771-5814 Space: 55,000 a,b,c,d,e

Hibbing Electronics
3125 E. 14th Ave. Hibbing, MN 55746 Michael Walsh Phone: (218) 263-8971 Fax: (218) 263-8970 Space: 86,000 a,b,c,d,e,f

Manu-Tronics
8701-100th St. Kenosha, WI 53142 Roger R. Mayer Phone: (414) 947-7700 Fax: (414) 947-7729 a,b,c,d,e,f

MEP Controls
312 Rising Sun Rd. Bordentown, NJ 08505 John Trainor Phone: (609) 298-7303 Fax: (609) 298-1982 Space: 50,000 a,b,c,d Customers: Stonite, Research Cottvell

MiNT
2650 E. Elvira Blvd. Tucson, AZ 85706 Gail Holman Phone: (602) 741-6468 Fax: (602) 741-6419 Space: 54,000 a,b,c,d,e

Pensar
2222 E. Pensar Dr. Appleton, WI 54915 Stan Plzak Phone: (414) 739-4355 Fax: (414) 739-4548 Space: 40,000 a,c,d,e

Praegitzer Industries
1270 Monmouth Cut-Off Dallas, OR 97338 Marty Filsinger Phone: (503) 623-9273 Fax: (503) 623-2303 Space: 225,000 a,b,c,d,e Customers: Protocol Systems, Intel

Senior Systems Technology
20150 Sunburst St. Chatsworth, CA 91311 Ron Viano Phone: (800) 800-0778 Fax: (818) 998-0664 Space: 54,000 a,b,c,d,e,f Customers: Xerox, IBM, Motorola

Swire Technologies
2099 Gateway Place San Jose, CA 95110 Martin Paul Phone: (408) 452-7474 Fax: (408) 452-7488 Space: 40,000 e Customers: LSI Logic, NCR Microelectronics, Motorola SPS

XCEL
4290 E. Breckell St. Ontario, CA 91761 Sam Calvillo Phone: (714) 391-4321 Fax: (714) 391-4558 Space: 100,000 a,b,c,d,e,f Customers: SCI, Allied-Bendix, Hurco, Dresser-Wayne

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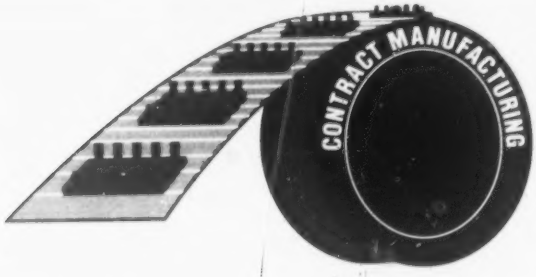


$5 million to $20 million in revenue

Type of service

- **a** Design
- **b** Product assembly
- **c** Turnkey manufacturing
- **d** Testing
- **e** Surface mount
- **f** Cable assembly

4th Generation
4 Pheasant Run Newtown, PA 18940 Tony Tartaglia Phone: (215) 968-5700 Fax: (215) 968-6094 Space: 25,000 a,b,d,e,f Customers: IBM, General Electric, Boeing

ADCO Circuits
1900 Northfield Dr. Rochester Hills, MI 48309 Archie Damman Phone: (313) 853-6620 Fax: (313) 853-6698 Space: 23,000 a,b,c,d,e,f Customers: Ford Motor, General Dynamics

Altek
245 East Elm St. Torrington, CT 06790 Stephen Altschuler Phone: (203) 482-7626 Fax: (203) 496-7113 Space: 26,000 a,b,c,d,e,f

Altron
6700 Industry Ave. NW Anoka, MN 55303 Alan Phillips Phone: (612) 427-7735 Fax: (612) 427-3980 Space: 65,000 a,b,c,d,e,f Customers: Rosemount, Honeywell, E-Systems

Bibco
326 E. Main St. Benton Harbor, MI 49022 Phil Wilcox Phone: (616) 925-8445 Fax: (616) 925-3081 Space: 40,000 b,f Customers: Zenith, Data Systems, AT&T, ITT

CY Tech
1933 18th St. N.W. #C-1 Washington, D.C. 20009 Yogi Sood Phone: (202) 986-0200 Fax: (202) 265-7766 Space: 40,000 b,c,d,e Customers: Western Digital, Seagate Technology

CIM Systems
Lladro Bldg., Flat K 72 Hoi Yuen Rd., Kwun Tong, Kowloon, Hong Kong Peter Yim Phone: (852) 3-416-378 Fax: (852) 3-412-416 Space: 30,000 a,b,c,d,e Customers: Camintonn, Talking Technology, Dell

Colt Technology
15301 W. 109th St. Lenexa, KS 66219 Jeffrey S. Lynn Phone: (913) 888-1673 Fax: (913) 888-3666 Space: 170,000 a,b,c,d,e,f Customers: AT&T, Allied Signal, PPG

Continental Testing Laboratories
8385 S. Highway 17-92 Fern Park, FL 32703 R.J. Urlocker Phone: (407) 831-2700 Fax: (407) 260-2053 Space: 35,000 d Customers: General Electric, Allied Signal, McDonnell Douglas

Da-Tech
141 Railroad Dr. Ivyland, PA 18974 Bradford W. Bentz Phone: (215) 322-9410 Fax: (215) 322-9730 Space: 50,000 a,b,c,d,e Customers: Honeywell, Ametek, Brookfield Engraving

Data Signal
2403 Commerce La. Albany, GA 31708 William Sanders Phone: (912) 883-4703 Fax: (912) 884-4766 Space: 22,500 a,b,c,d,e,f Customers: Motorola, Select Manufacturing

Diagnostic Instrument
4 Copeland Dr. #J Ayer, MA 01432 James F. Hashem Phone: (508) 772-4572 Fax: (508) 772-5210 Space: 15,000 b,c,d,e Customers: Kodak, Raytheon

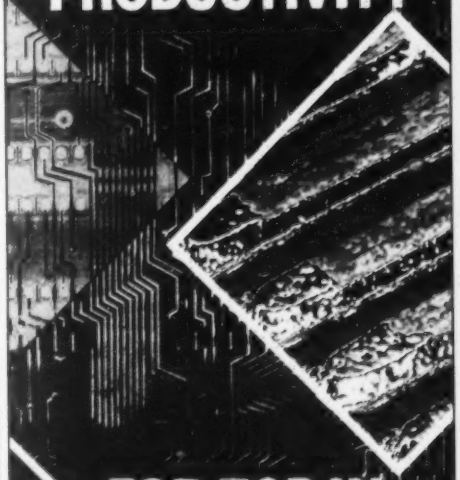
ETMA
15450 N.E. 95th St. Redmond, WA 98052 John Rapp Phone: (206) 885-0107 Fax: (206) 882-3516 Space: 30,000 b,c,d,e,f

Electronics Systems
Box 5013 Sioux Falls, SD 57117 Leo Reynolds Phone: (605) 338-6868 Fax: (605) 338-5061 Space: 35,000 a,b,c,d,e

continued

SURFACE MOUNT TECHNOLOGY FOR CIRCUIT BOARD ASSEMBLY

PRODUCTIVITY



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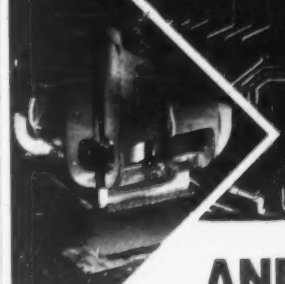

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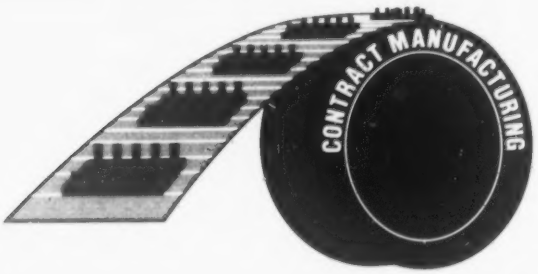


Epic Technologies
200 E. Bluegrass Dr. Norwalk, Ohio 44857 Scott Benincasa Phone: (419) 668-8117 Fax: (419) 668-2819 Space: 27,500 a,b,c,d,e Customers: Packard Electric, Bailey Controls

Express Manufacturing
3115 W. Warner Ave. Santa Ana, CA 92704 C.P. Chin Phone: (714) 556-1878 Fax: (714) 555-3199 Space: 56,000 a,b,c,d,e Customers: Xirox, Advanced Logic Research, Xircom

General Technology
6816 Washington NE Albuquerque, NM 87109 Don Dugger Phone: (505) 345-5591 Fax: (505) 344-3227 Space: 35,000 b,c,d,f Customers: McDonnell-Douglas, Bell Helicopter, Sikorsky

Kimchuk
Commerce Park, Corporate Dr. Danbury, CT 06810 Robert Glen Phone: (203) 790-7800 Fax: (203) 797-8976 Space: 100,000 a,b,c,d,e,f Customers: IBM, Stratus Computer

Micro Industries
8399 Green Meadows Dr. North Westerville, OH 43081 Bill Jackson Phone: (614) 548-7878 Fax: (614) 548-6184 Space: 40,000 a,b,c,d,e

NCR Component Evaluation
Space Technology Center 3450 North Rock Rd. #100 Wichita, KS 67226 Richard Guy (316) 636-4800 Phone: (316) 636-4780 Space: 30,000 d,e Customers: Siemens, Honeywell, Texas Instruments

Pine Instrument
101 Industrial Dr. Grove City, PA 16127 David Savage Phone: (412) 458-6391 Fax: (412) 458-4648 a,b,c,d,f

Type of service
- **a** Design
- **b** Product assembly
- **c** Turnkey manufacturing
- **d** Testing
- **e** Surface mount
- **f** Cable assembly

Precision Graphics
59 LaGrange St. Raritan, NJ 08869 Robert Weissman Phone: (201) 707-8880 Fax: (201) 707-8884 Space: 14,500 a,b,c,d,e,f Customers: AT&T Network Systems, Amietek, Dialogic

RAMP Industries
1 North Floral Ave. Binghamton, NY 13905 Charles Faciszewski Phone: (607) 729-5256 Fax: (607) 729-2977 Space: 150,000 b,c,d,e,f

Southtronics
1265 Kennestone Cir. Marietta, GA 30066 David T. Coleman Phone: (404) 429-1000 Fax: (404) 424-2000 Space: 20,000 a,b,c,d,e

Superior Manufacturing
3133 W. Harvard St. Santa Ana, CA 92704 Jim Van Landingham Phone: (714) 540-4605 Fax: (714) 540-4542 Space: 60,000 a,b,c,d,e,f Customers: Advanced Logic Space, Research, ITT Cannon, Birtcher

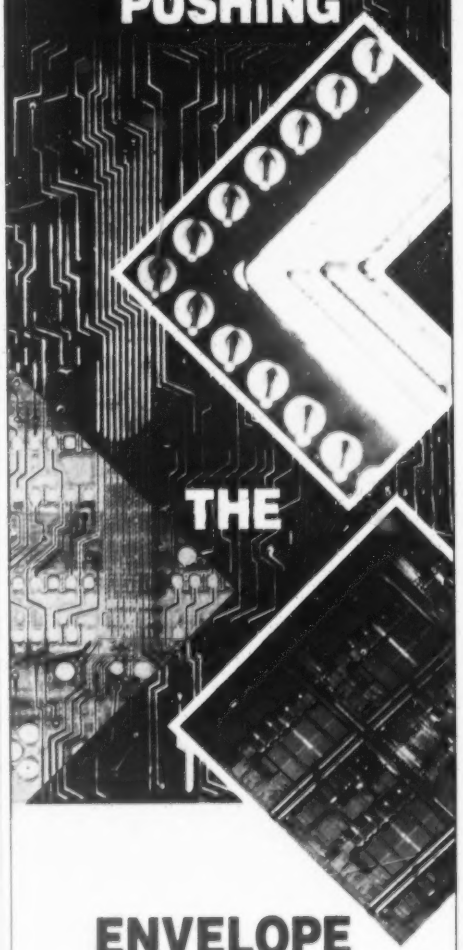
Thai Micro Systems
2350 Mission College Blvd. #480 Santa Clara, CA 95054 Ernie Barrieau Phone: (408) 982-3807 Fax: (408) 988-3889 b,e

Turtle Mountain
380 Oak Grove Pkwy. St. Paul, MN 55127 Van Barkus Phone: (612) 481-1427 Fax: (612) 481-7253 Space: 52,000 b,c,d,e,f Customers: 3M, IBM, Tennant, Paramax, McDonnell Douglas

continued

ADVANCING TECHNOLOGIES FOR CIRCUIT BOARD ASSEMBLY

PUSHING THE ENVELOPE



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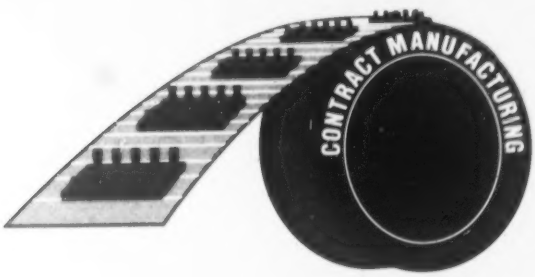

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201 N. Gables Blvd. Wheaton, IL 60187 Vern Kiebler Phone: (708) 668-5407 Fax: (708) 462-7590 Space: 44,000 a,b,c,d,e,f Customers: Dow Chemical, Caterpillar, Arachnid

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Merrifield, MN 56465 Jeff Zernov Phone: (218) 765-3151 Fax: (218) 765-3900 Space: 35,000 a,b,c,d,f Customers: Westinghouse, IBM, Sony

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Type of service

- **a** Design
- **b** Product assembly
- **c** Turnkey manufacturing
- **d** Testing
- **e** Surface mount
- **f** Cable assembly

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Diversified Electronic
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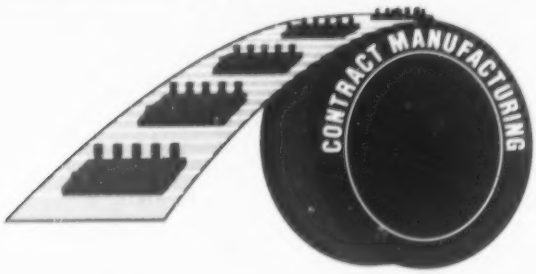

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Type of service
- **a** Design
- **b** Product assembly
- **c** Turnkey manufacturing
- **d** Testing
- **e** Surface mount
- **f** Cable assembly

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SeaFab
14648 NE 95th St. Redmond, WA 98052 Bruce Murray Phone: (206) 881-2778 Fax: (206) 882-0707 Space: 11,000 a,b,c,d

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3920 Lennane Dr. Sacramento, CA 95834 Ken McKee Phone: (916) 928-9481 Fax: (916) 928-1338 Space: 40,000 a,b,c,d,e,f

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4025 Sorrento Valley Blvd. San Diego, CA 92121 Duane Sorlie Phone: (619) 452-4160 Fax: (619) 450-9639 Space: 12,000 c,d Customers: Gould, AMI, Texas Instruments

Trionics
704 E. North St. Elburn, IL 60119 James Teppo Phone: (708) 365-6570 Fax: (708) 365-6575 Space: 18,000 a,b,c,d,e,f Customers: ITW, Eaton, Capsonic

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9465 Custom House Plaza #D San Diego, CA 92173 John Riley Phone: (619) 661-6868 Fax: (619) 661-1229 Space: 30,000 b,d,e,f Customers: SGS Thomson, Rantec Microwave & Electronics

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VIEWPOINT

Let's rewrite the contract between business and ourselves

The recent link-up between international giants IBM, Siemens, and Toshiba to develop the next generation of memory IC's illustrates how dead the notion of an independent national corporation is becoming. Although hardly the norm—yet—this match-up demonstrates how much faster corporate structures evolve than government ones. Barring war, unforgiving market pressures are far more potent (and productive) agents of change than state powers. That, however, creates a dilemma.

On the one hand, how can a corporation—whose financial well-being doesn't necessarily imply creating jobs, technology, or wealth for a specific nation—fulfill its obligations to increase shareholders' value and, at the same time, help to improve the standard of living for those in its home country? Under current legal conditions, U.S. public companies can't, and some would argue they shouldn't.

On the other hand, how can a government—whose primary purpose is to ensure the well-being of a geographically-bound population—promote an improved standard of living for its constituents while also providing a non-intrusive environment that promotes corporate success?

The conflicts are most clear in international joint ventures. Consider the following example. When IBM and Toshiba created a jointly owned company to develop and manufacture flat panel displays, there was considerable discussion over where to build the plant. In the end, it was built in Japan. Had it been built in the U.S., the country would have gained jobs, technology transfer, and a boost to the infrastructure. Other business considerations took precedence—perhaps rightly so. IBM's goals are not necessarily those of the U.S. Toshiba's goals are certainly not. Perhaps neither's should be.

My point is this. We must find a way to redefine the relationship between business and government. Often, their goals conflict. That's not bad in itself. The problem is that industry is the real creator of wealth—not government—but industry doesn't care where that wealth is developed as long as shareholder value is increased. Government creates very little wealth, yet its job is to ensure that wealth is created among its citizens.

Somehow, we must bring these two ideas together. We must bring them together for the specific benefit of the U.S.—not just the general benefit of the international business community. It's time to rethink the social contract between businesses and their host countries. More government is not the answer. More business is.

—John Russell, editor

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